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ABSTRACT

The Third International Mathematics and Science Study (TIMSS) is one of the most comprehensive international studies of schooling and students' achievement in science and mathematics. TIMSS was originally conducted in 1995. Four years later in 1999, the Third International Mathematics and Science Study-Repeat (TIMSS-R) was conducted. This document presents information on how U.S. eighth grade students performed in both studies and questions whether there have been any significant changes in achievement from an international perspective. Contents are divided into four chapters. Chapter 1 explains the importance of international comparison in education and the reasons for repeating TIMSS, identifies questions used and participating countries, discusses how the research was conducted, and presents the organization of the report. Chapter 2 discusses the mathematics and science achievement of the eighth grade students and presents student scores in both studies. Chapter 3 reviews issues related to curriculum and teaching, confidence levels of teachers, professional development, peer cooperation and classroom practices, and activities. Chapter 4 presents questions raised by the results of this report. (YDS)

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Statistical Analysis Report May 2001

Pursuing Excellence:

Comparisons of International Eighth-Grade Mathematics and Science Achievement from a U.S. Perspective, 1995 and 1999

Initial Findings from the
Third International Mathematics and Science Study – Repeat

Office of Educational Research and Improvement
U.S. Department of Education

NCES 2001-028

Pursuing Excellence: Comparisons of International Eighth-Grade Mathematics and Science Achievement from a U.S. Perspective, 1995 and 1999

Initial Findings from the Third International Mathematics and Science Study—Repeat

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This report, *Pursuing Excellence: Comparisons of International Eighth-Grade Mathematics and Science Achievement from a U.S. Perspective, 1995 and 1999*, is a collaborative effort by the National Center for Education Statistics (NCES), the National Science Foundation (NSF), and the Office of Educational Research and Improvement (OERI). NCES is responsible for the analyses presented in this report. Funding for the U.S. portion of the Third International Mathematics and Science Study–Repeat (TIMSS–R) was provided by NCES and NSF, with additional funding from OERI.

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A report of this nature and scope is never only the work of its authors. There are teams of people who, behind the scenes, make substantial contributions of content and process that move a report like this one toward completion. The authors wish to thank all those who contributed to the design, writing, and production of this report for their thoughtful critique, insightful suggestions, and creativity.

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Commissioner's Statement

The Third International Mathematics and Science Study–Repeat (TIMSS–R) is the latest chapter in one of the most comprehensive and rigorous international studies of schooling and student achievement ever conducted. TIMSS–R, conducted in 1999, comes 4 years after TIMSS, and was designed to focus on the mathematics and science achievement of eighth-grade students. NCES and the National Science Foundation (NSF) supported the United States' participation in TIMSS–R to provide an update on the mathematics and science performance of U.S. eighth-grade students originally detailed in the 1995 TIMSS study. This report, *Pursuing Excellence: Comparisons of International Mathematics and Science Achievement from a U.S. Perspective, 1995 and 1999*, presents initial findings on how our eighth-grade students fared on TIMSS–R and whether there have been significant changes in achievement in the four years since TIMSS.

TIMSS–R addresses the mission of NCES to gather and publish information on the status and progress of education in the United States and other nations, and continues the tradition of U.S. participation in international comparative studies of mathematics and science education since the 1960s. TIMSS–R represents an advancement in traditional studies because it is the first international study specifically designed to track changes in achievement. The data on mathematics and science achievement collected in TIMSS–R can be compared to the 1995 TIMSS data to identify changes between the eighth-grade students of yesterday and today, and relative changes between fourth-grade students 4 years earlier and their classmates 4 years later. While the same students did not participate in both studies, a scientific sampling of the two groups of students provides the most accurate picture available of their mathematics and science performance from an international comparative perspective. Information from TIMSS–R, in combination with what we have learned from the National Assessment of Educational Progress (NAEP), provides an opportunity to take stock of mathematics and science performance of our students.

One of the most important steps in making good decisions is to have good data. TIMSS–R fills that need and is one of the many surveys and assessments conducted by NCES that can be used by U.S. educators, parents, policymakers, and business leaders to make important decisions that will improve student learning. In addition to data on student performance, TIMSS–R includes a wealth of information on the context within which student learning takes place, such as teaching practices, students' study habits, teacher training and professional development, and school policies. Taken into consideration with other knowledge about the education systems of participating nations, TIMSS and TIMSS–R provide a thoughtful and in-depth look into what our eighth-grade mathematics and science teachers teach and what our eighth-grade students learn in comparison to their counterparts in other nations of the world.

In conclusion, TIMSS–R is a learning experience. The information presented in this report is presented in a straightforward way, and is not intended to determine whether U.S. performance is good or bad. Rather, it is intended to provide you, the reader, with the most accurate and up-to-date information available. The importance of this information, and its impact on American education, will depend on how it is used to improve our mathematics and science education. My colleagues and I invite everyone dedicated to enhancing the quality of our nation's mathematics and science education to make the fullest possible use of this rich resource.

Gary W. Phillips

Gary W. Phillips
Acting Commissioner of Education Statistics

December 2000

NSF Director's Statement

It is critical that students in the United States achieve at high levels in mathematics and science. The position of the U.S. in the world economy, the continuing demand for well-trained mathematicians and scientists, and the need for an informed citizenry able to make intelligent public-policy decisions about important economic, medical, and environmental issues all depend upon it.

Studies such as TIMSS–R help us place the achievement of U.S. students into an international context and thus provide important additional sources of information for evaluation of student abilities. The National Science Foundation (NSF) has co-funded the TIMSS–R study and has actively participated in its management for this reason.

The careful design of the TIMSS–R study provides an opportunity to analyze trends in the achievement of eighth-grade students in the 23 countries that participated in both 1995 and 1999. The results show that U.S. eighth-grade students continue to perform at the international average in science and just below the international average in mathematics, with no statistically significant changes in their level of achievement from 1995 to 1999. Indeed, this is true for most of the countries participating in both years, although some countries (e.g., Canada) did make significant gains. A thorough analysis of the reasons for these exceptional gains may provide insight into possible strategies for improving education in the United States.

The timing of TIMSS–R allows us to compare results across grades in the 17 nations that participated in both the fourth-grade TIMSS in 1995 and the eighth-grade TIMSS–R in 1999. It is disturbing that the international ranking across these 17 nations of the U.S. eighth-grade students is relatively poor in both mathematics and science when compared with that of U.S. fourth-graders in 1995. This confirms the disappointing showing of our eighth-grade students in international comparisons, and demonstrates that the decline in relative performance during the middle school years is a continuing and serious problem.

The initial TIMSS study indicated that student achievement is the result of multiple factors. In schools, curriculum, teacher qualifications, and high expectations for all students are critical. Other factors, such as the educational resources available to the family, also may be key to student success. For example, achievement differences found between student groups or by type of school may be narrowed or eliminated when parent education and home resources are used in the analyses.

This first TIMSS–R report does not analyze the relationships between contextual variables and student achievement. However, it contains a preliminary comparison of the U.S. with other nations on a number of factors. For example, U.S. eighth-grade teachers are less likely to have majors and minors in mathematics and science than their counterparts in most other countries. This finding is consistent with other reports such as *Before It's Too Late: A Report to the Nation from the National Commission of Mathematics and Science Teaching for the 21st Century.*

We look forward to further analysis of the data in this report, the release of data from 27 U.S. benchmarking jurisdictions that engaged in TIMSS–R as if they were separate nations, and the companion classroom video studies. These will enrich our understanding of the factors that contribute to the disappointing achievement levels of U.S. eighth-grade students. Similar detail from the 1995 TIMSS study revealed the importance of rigorous mathematics and science curricula and alerted researchers to the need for teachers to have deep content knowledge in order to use those curricula successfully and achieve high standards for all students.

NSF is pleased to have supported this important study and report. The data contained within the TIMSS–R study will be used for years to understand issues and trends in the teaching of mathematics and science. Simply said, it is an invaluable resource.

Rita R. Colwell

Rita R. Colwell
Director
National Science Foundation

December 2000

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CHAPTER 1

INTRODUCTION

The National Science Foundation (NSF), the U.S. Department of Education's Office of Educational Research and Improvement (OERI), and the National Center for Education Statistics (NCES) joined together to support the participation of the United States in the Third International Mathematics and Science Study–Repeat (TIMSS–R), a successor to the 1995 Third International Mathematics and Science Study (TIMSS).[1] The joint research effort has produced rich information on the mathematics and science performance of U.S. eighth-grade students. This report, *Pursuing Excellence: Comparisons of International Eighth-Grade Mathematics and Science Achievement from a U.S. Perspective, 1995 and 1999* presents initial findings from the TIMSS–R study.

Why are international comparisons of education important?

International comparisons of student achievement and various background factors related to teaching and learning have been conducted for over 30 years. Many observers believe that such comparisons can help policymakers, researchers, teachers, and parents understand what other nations do to further the educational achievement of their populations. Some also believe that if the United States wants to remain internationally competitive, we need to better understand how our students perform in critical areas such as mathematics and science. Moreover, some are of the opinion that international assessments are one way of seeing what our national, state, and local standards mean in a world context. In short, international assessments can expand comparisons of educational achievement to other systems outside the United States; aid in our understanding of the possible reasons for observed differences in achievement; document the many varied education and learning practices around the world; get a sense of resources available to students in different nations; and improve the study of education itself (Board on International Comparative Studies in Education, 1990; Medrich and Griffith 1992).

Why a repeat of TIMSS?

The series of NCES reports on the 1995 TIMSS study described the mathematics and science performance of U.S. students in comparison to their peers at three different grade levels (NCES 1996, 1997c, 1998, 2000a).[2] The 1995 TIMSS assessments revealed that U.S. fourth-graders performed well in both mathematics and science in comparison to students in other nations, U.S. eighth-grade students performed near the international average in both mathematics and science, and U.S. twelfth-graders scored below the international average and among the lowest of the TIMSS nations in mathematics and science general knowledge, as well as in physics and advanced mathematics.

The participation of the United States in TIMSS heightened the nation's interest in improving mathematics and science education. Although work on improving mathematics and science education began years before TIMSS, results from TIMSS have had an impact on the way the United States thinks about mathematics and science education (Welch 2000).

TIMSS–R continues the tradition of international comparative study of mathematics and science education begun in the 1960s. The contribution of TIMSS–R is unique, however, because its design makes it possible to track changes in achievement and certain background factors from the earlier TIMSS study—a first for any international study. Moreover, TIMSS–R is the first international assessment that provides some indication of the pace of educational change across nations, informing expectations as to what can be achieved. TIMSS–R provides valuable information on the state of education in the United States and other nations in 1999.

Thirty-eight nations chose to compare the mathematics and science performance of their students in 1999. However, unlike TIMSS, the 1999 TIMSS–R study focused on eighth-grade students only. TIMSS–R allows the United States to compare the achievement of its eighth-graders in

[1]TIMSS collected data during the 1994–95 school year. TIMSS–R collected data during the 1998–99 school year. For convenience, reference will be made to 1995 and 1999, respectively, throughout this report.

[2]See appendix 1 for a brief list of TIMSS-related publications.

the original TIMSS to the scores of its eighth-graders four years later in TIMSS–R. It also provides an opportunity for the United States to compare the relative performance of a cohort of fourth-graders in 1995 to the relative performance of a cohort of eighth-graders 4 years later in 1999.[3] In short, TIMSS–R should help us understand the overall progress that our schools, teachers, and students are making toward achieving excellence in mathematics and science.

What questions does this report address?

This report highlights initial findings on the performance of U.S. eighth-grade students relative to students in other nations on the TIMSS–R assessment. This report also describes the mathematics and science performance of students in participating nations at two points in time: 1995 and 1999.

In general, this report addresses the following questions:

- How does the mathematics and science knowledge of U.S. eighth-grade students compare to that of students in other nations?
- Has the level of mathematics and science knowledge of eighth-grade students changed since 1995, and has the relative international standing of U.S. eighth-grade students changed in the 4 years since the original TIMSS?
- How does the relative performance of U.S. eighth-grade students in 1999 compare to the relative performance of U.S. fourth-grade students 4 years earlier, in 1995?
- How do nations compare on education-related background factors studied in TIMSS–R?

Performance in the United States is presented relative to that of other nations that participated in each assessment.[4] Comparisons in this report are made among the 38 nations that participated in TIMSS–R in 1999; among 23 nations that participated in both TIMSS and TIMSS–R at the eighth-grade level; and among the 17 nations that participated at the fourth-grade level in TIMSS and at the eighth-grade level in TIMSS–R.[5] This report is based on the comparative data published in the reports *TIMSS 1999 International Mathematics Report: Findings from IEA's Repeat of the Third International Mathematics and Science Study at the Eighth Grade* (Mullis et al. 2000) and *TIMSS 1999 International Science Report: Findings from IEA's Repeat of the Third International Mathematics and Science Study at the Eighth Grade* (Martin et al. 2000).

What issues does this report not address?

Findings from comparisons between the results of TIMSS and TIMSS–R cannot be interpreted to indicate the success or failure of mathematics and science reform efforts in the United States. TIMSS–R was designed to specifications detailed in the TIMSS curriculum frameworks (Robitaille et al. 1993). International experts developed the TIMSS curriculum frameworks to portray the structure of the intended school mathematics and science curricula from many different nations, not specifically the United States. Thus, when interpreting the findings, it is important to take into account the mathematics and science curricula likely encountered by U.S. students in school. TIMSS and TIMSS–R results are most useful when they are considered in light of other knowledge about education systems, including not only curricula, but also factors such as trends in education reform, changes in the school-age populations, and societal demands and expectations.

[3]Comparisons of fourth- and eighth-graders between TIMSS and TIMSS–R are made on the basis of two sets of cross-sectional, nationally representative samples.

[4]Participants in TIMSS and TIMSS–R are referred to as nations throughout the text. However, several of the participants are not independent jurisdictions, as is the case for Hong Kong, Special Administrative Region (SAR), Belgium-Flemish, and Chinese Taipei.

[5]Throughout the text "grade 8" refers to the middle-school grade sampled for TIMSS-R as well as the higher of the two middle-school grades sampled for TIMSS; "grade 4" refers to the higher of the two elementary school grades sampled for TIMSS. This is an accurate characterization of the samples for the United States and many of the other nations. Detailed information on the grades sampled can be found in appendix 2 of this report for TIMSS–R and in Beaton et al. (1996a and 1996b) for TIMSS.

Change efforts in the United States began years before TIMSS and TIMSS–R. These efforts to create change in U.S. schools have been undertaken at the state and local levels, making it difficult to determine by solely examining national-level statistics the extent to which these efforts have been implemented and the degree and depth of the changes made. The 4 years between TIMSS and TIMSS–R is a relatively short amount of time to expect to see significant change. Finally, this report focuses on variability in achievement among nations. It is important to keep in mind that the range of achievement observed among nations could also be expected to be observed within the United States (NCES 1997a and 1997b; Johnson and Siegendorf 1998). Thus, as will be shown later in the report, there are U.S. eighth-grade students who perform among the top-performing students in the world, and there are U.S. eighth-grade students who perform among the lowest performing students in the world.

This report should also not be construed to suggest that specific school policies, professional development techniques, instructional practices, curricula or change strategies, or combinations of these will lead to higher levels of achievement. The factors that may contribute to high achievement can vary from nation to nation. Nonetheless, TIMSS–R provides valuable information that can help the United States reflect on its own performance relative to other nations as we strive to improve educational opportunities for all students.

What is TIMSS–R?

TIMSS–R is the fourth comparison of mathematics and science achievement carried out by the International Association for the Evaluation of Educational Achievement (IEA). IEA conducted studies of mathematics and science as separate subjects at various times during the 1960s, 1970s, and 1980s. The United States participated in each of these studies. The Third International Mathematics and Science Study (TIMSS) collected data during the 1994–95 school year. TIMSS provided an update on the performance of U.S. students in mathematics and science during the mid-1990s and a starting point for a regular cycle of international assessments in mathematics and science. Funded by the U.S. Department of Education, NSF, the Government of Canada, the World Bank, and participating nations, TIMSS was the first IEA study to combine both mathematics and science in the same assessment. TIMSS was also the largest and most comprehensive international study of educational achievement ever undertaken.

TIMSS–R follows the earlier TIMSS study by 4 years and focused on the mathematics and science achievement of eighth-grade students. Most importantly perhaps, TIMSS–R provides a second data point in a regular cycle of international assessments of mathematics and science that are planned to chart trends in achievement over time, much like the regular cycle of national assessments in this nation, such as the National Assessment of Educational Progress (NAEP), or longitudinal studies such as the National Educational Longitudinal Study (NELS:88).

The United States sponsored three additional components of TIMSS–R that will enrich our knowledge of education in an international context:

- TIMSS–R Benchmarking Project—Twenty-seven states, districts, and consortia of districts throughout the United States participated as their own "nations" in this project, following the same guidelines as the participating nations. When the findings from the Benchmarking Project are released in April 2001, these 27 participating jurisdictions will be able to assess their comparative international standing and judge their mathematics and science programs in an international context.
- Videotape Classroom Study—the first TIMSS Videotape Classroom Study examined eighth-grade mathematics teaching in three nations. Building on the work of the first TIMSS videotape study (Stigler et al. 1999), the TIMSS–R Videotape Classroom Study has been expanded in scope to examine national samples of eighth-grade mathematics and science instructional practices in seven nations. The study is designed to present national-level portraits of mathematics and science teaching practices that can provide a more detailed context for understanding

mathematics and science teaching and learning in the classroom. The first set of results from the Videotape Classroom Study is anticipated in late 2001.

- NAEP/TIMSS–R Linking Study—A subsample of students taking the 2000 state NAEP mathematics and science assessment also took the TIMSS–R assessment. This provides an opportunity to compare students' performance on NAEP to their performance on TIMSS–R, and allows for estimates of how states participating in NAEP 2000 would have performed had they participated in TIMSS–R. Results from the TIMSS–R Benchmarking Project will be used to check the results of this linking study. Results will be released in late 2001.

With many states and districts creating content and performance standards targeted at boosting student achievement to "world class" levels in mathematics and science, the Benchmarking Project can provide reliable data on how state and district students compare internationally in these areas. Results from the TIMSS–R Videotape Classroom Study should also add to our understanding of mathematics and science instructional practices in nations with high student achievement levels on assessments such as TIMSS. Findings from the NAEP/TIMSS–R Linking Study will provide states the opportunity to compare their students to their peers in other nations.

Which nations participated in TIMSS–R?

The IEA invited all nations that participated in the 1995 TIMSS as well as other nations to participate in the 1999 TIMSS–R. Interested nations met at international meetings where study plans and guidelines were discussed. Thirty-eight nations collected data for TIMSS–R, including 26 that had participated in TIMSS and 12 that were participating for the first time. Therefore, depending on the analysis, the number of nations being compared between TIMSS and TIMSS–R will change. The 38 nations that participated in TIMSS–R are shown in figure 1. In addition, figure 1 lists the nations that participated in both TIMSS and TIMSS–R.

How was TIMSS–R conducted?

The IEA, a Netherlands-based organization of education and research institutions from its member nations, conducted TIMSS–R. The IEA delegated responsibility for the overall coordination and management of the project to the International Study Center at Boston College. The United States, the World Bank, and participating nations paid for and carried out data collection according to international guidelines.

NCES and NSF funded the collection of data in the United States and also contributed toward support of the international project. OERI has contributed additional funding towards the U.S. portion of the study. Westat, Inc., a private research firm, handled the data collection in the United States under contract to the Department of Education. To help guide the study, NCES and NSF established a TIMSS–R Technical Review Panel (TRP). The members of the TRP are experts in mathematics and science education, assessment, and international comparative studies.

TIMSS–R included two types of data collection instruments: mathematics and science assessment items in multiple-choice (77 percent) and free-response (23 percent) formats; and school, teacher, and student questionnaires that requested information to help provide a context for the performance scores. An international panel of assessment and content experts, following the same assessment framework established for TIMSS, developed the mathematics and science items in TIMSS–R. Like the TIMSS assessment items, the TIMSS–R items represent a range of mathematics and science topics that are included in the curricula of many different nations and, thus, not aligned to any particular curriculum. See appendix 2 for more details on the composition of the TIMSS and TIMSS–R assessments and how the achievement scores were derived.

Figure 1.—Participation in TIMSS and TIMSS–R: 1995 and 1999

	TIMSS-R nations (1999) 8th grade	TIMSS-R nations that participated at 8th grade in TIMSS (1995)	TIMSS-R nations that participated at 4th grade in TIMSS (1995)
	Australia	Australia	Australia
	Belgium-Flemish[1]	Belgium-Flemish[1]	
	Bulgaria	Bulgaria	
	Canada	Canada	Canada
	Chile		
	Chinese Taipei		
	Cyprus	Cyprus	Cyprus
	Czech Republic	Czech Republic	Czech Republic
	England	England	England
	Finland		
	Hong Kong SAR	Hong Kong SAR	Hong Kong SAR
	Hungary	Hungary	Hungary
	Indonesia		
	Iran, Islamic Republic of	Iran, Islamic Republic of	Iran, Islamic Republic of
	Israel	Israel	
	Italy	Italy[2]	Italy[2]
	Japan	Japan	Japan
	Jordan		
	Korea, Republic of	Korea, Republic of	Korea, Republic of
	Latvia-LSS[3]	Latvia-LSS[3]	Latvia-LSS[3]
	Lithuania	Lithuania	
	Macedonia, Republic of		
	Malaysia		
	Moldova		
	Morocco		
	Netherlands	Netherlands	Netherlands
	New Zealand	New Zealand	New Zealand
	Philippines		
	Romania	Romania	
	Russian Federation	Russian Federation	
	Singapore	Singapore	Singapore
	Slovak Republic	Slovak Republic	
	Slovenia	Slovenia	Slovenia
	South Africa	South Africa	
	Thailand	Thailand	
	Tunisia		
	Turkey		
	United States	United States	United States
Total Nations	38	26	17

[1]The Flemish and French educational systems in Belgium participated separately in TIMSS 1995. The Flemish educational system in Belgium participated in TIMSS-R 1999.

[2]Italy was unable to provide the International Study Center at Boston College with its data in time for these data to be included in the international reports for both the fourth and eighth grade in TIMSS 1995. However, its data for TIMSS 1995 are included in this report.

[3]Designated LSS because only Latvian-speaking schools were tested.

NOTE: Only nations that completed the necessary steps for their data to appear in the reports from the International Study Center at Boston College are listed.

SOURCE: Mullis et al. (2000). *TIMSS 1999 International Mathematics Report: Findings from IEA's Repeat of the Third International Mathematics and Science Study at the Eighth Grade.* Exhibit A.1. Chestnut Hill, MA: Boston College.

The questionnaires asked for information on topics such as students' attitudes and beliefs about learning, study habits and homework, and their lives both in and outside of school; teachers' attitudes and beliefs about teaching and learning, teaching assignments, class size and organization, instructional practices, and participation in professional development activities; and principals' viewpoints on policy and budget responsibilities, curriculum and instruction issues, student behavior problems, as well as descriptions of the organization of schools and courses.

Both public and nonpublic school students in all participating nations received the TIMSS–R assessments and questionnaires. Most nations, including the United States, conducted the assessment 2 to 3 months before the end of the 1998–99 school year. Students with special needs and disabilities that would make it very difficult for them to take the test were excused from the assessment as accommodations were not offered in TIMSS–R in the United States. Each participating nation documented such exclusions, including the United States. Each nation translated the assessments and questionnaires into the primary language or languages of instruction. In the United States, all materials were in English. The student assessment portion required approximately one and a half hours to complete.

All participating nations drew nationally representative samples of students. In the United States, the sample consisted of 221 schools and 9,072 eighth-grade students, which ensured a representative sample of eighth-grade students in the United States as a whole. Detailed information on sampling is provided in appendix 2.

Are the results from TIMSS and TIMSS–R comparable?

The data collected for TIMSS in 1995 and the data collected for TIMSS–R in 1999 are comparable because comparability was built into the design and implementation. Through a careful process of review, analysis, and refinement, the assessment and questionnaire items were purposefully developed and field tested for similarity and for reliable comparisons between TIMSS and TIMSS–R. After careful review of all available data, including a test for item reliability between old and new items, the TIMSS and TIMSS–R assessments were found to be very similar in format, content, and difficulty level. Moreover, TIMSS and TIMSS–R data are on the same eighth-grade scale to allow for reliable comparisons between the two eighth-grade cohorts over time. Procedures for conducting the assessments were the same. Appendix 2 contains more detailed information on these and other technical aspects of TIMSS–R.

How can we be sure the data are comparable across nations?

TIMSS–R continues the tradition of fair and accurate international comparisons of student achievement and other educational factors. It is not a comparison of other nations' best students to our nation's average students. Moreover, through the refinement of the scaling process that allows comparisons within and across nations, the TIMSS and TIMSS–R achievement scores can be reliably compared. To ensure the comparability of data across nations, the International Study Center at Boston College instituted a series of strict quality-control procedures. National school and student samples were rigorously reviewed for bias and international comparability by the TIMSS–R Sampling Referee. A professional translation agency verified the accuracy of translated materials. Project coordinators in each nation received thorough training in data collection and scoring procedures and their work was monitored for scoring reliability. Quality control staff conducted site visits in each participating nation during the testing period to further ensure that international data collection procedures were followed. Data from each nation were extensively reviewed for internal and cross-country consistency.

Nations collected data from a representative national sample of students, but were permitted to supplement their student samples to allow for the analysis of data by variables of national interest. To obtain reliable comparisons among nations, the data were appropriately weighted to account for sampling designs. Sampling and participation rate irregularities arose in some nations. These irregularities are clearly noted in this and other TIMSS–R reports. The United States met all international sampling and participation guidelines. More detailed information on quality control can be found in appendix 2 and the *TIMSS 1999 Technical Report* from Boston College (Martin and Gregory 2000).

Finally, it should be noted that in addition to the 38 nations that participated in TIMSS–R in 1999, this report separately discusses the 23 that participated in TIMSS at the eighth-grade level,[6] and the 17 TIMSS-R nations that participated in TIMSS at the fourth-grade level (see figure 1).[7] In order to make a fair comparison of how U.S. eighth-grade students in 1999 compared to the eighth-graders of 1995 or the fourth-graders of 1995, analyses were conducted only among those nations that participated in both TIMSS and TIMSS–R.

How does TIMSS–R relate to other large-scale studies of mathematics and science achievement?

TIMSS–R is one of several large-scale studies designed to examine the mathematics and science performance of students. Two other large-scale studies of mathematics and science achievement are the National Assessment of Educational Progress (NAEP) and the Program for International Student Assessment (PISA). NAEP is an ongoing program that has reported on the mathematics and science achievement of U.S. students for some 30 years. PISA is a relatively new international project and will report results for the first time in late 2001. These three assessments were designed with different purposes in mind, and this is evident in the types of assessment items as well as the content areas and topics covered in each assessment.

TIMSS–R and NAEP assess students at the eighth grade. TIMSS–R is based on the curricula that students in participating nations are likely to have encountered by grade 8, while NAEP is based on an expert consensus of what students in the United States should know and be able to do in various academic subjects at that grade. PISA, on the other hand, focuses on 15-year-old students (most often tenth-graders in the United States) and is designed to measure students' mathematics and science literacy—that is, students' ability to respond to "real life" situations both in and outside of school. In contrast, TIMSS–R and NAEP tend to focus on mathematics and science as it is generally presented in classrooms and textbooks.

All three assessments cover a range of mathematics and science content areas and topics, but to different degrees. In mathematics, for example, TIMSS–R appears to place more emphasis on number sense, properties and operations than the other two studies; PISA tends to emphasize data analysis more than the other two studies; and NAEP appears to distribute its focus across the content areas included in its assessment framework more than the other two studies. In science, TIMSS–R appears to emphasize physical sciences more than the other two assessments; PISA seems to have a stronger emphasis on earth science than TIMSS–R and NAEP; and NAEP appears to distribute most science items among three content areas: physical science, earth science, and life science. As findings from these studies are released, it is important to understand the differences and similarities among them to be able to make sense of the findings in relation to each other.

[6]Twenty-six nations participated in the eighth-grade level in TIMSS 1995 and TIMSS–R 1999. Three of the 26 nations—Israel, South Africa, and Thailand—experienced significant difficulties with meeting international sampling or participation guidelines in 1995. Therefore, these 3 nations are not included in analyses comparing achievement at the eighth-grade level between 1995 and 1999, nor are they included in the international averages associated with these comparative analyses.

[7]Of the 42 nations that participated in TIMSS 1995 at the eighth-grade level, 26 also participated in TIMSS–R. Of the 26 nations that participated in TIMSS 1995 at the fourth-grade level, 17 also participated in TIMSS–R. See table A2.6 in appendix 2 for a complete list of nations.

How is the rest of the report organized?

The remainder of the report includes three additional chapters and several appendices:

Chapter 2 describes the relative performance of U.S. eighth-grade students in mathematics and science in comparison to their peers in participating nations. The chapter is divided into three sections. First, achievement results for TIMSS–R are described for the United States and the other 37 participating nations, including overall mathematics and science achievement, achievement in five mathematics content areas and six science content areas, and proportions of students in the top 10 percent and top 25 percent of all students. Sample mathematics and science items are included to acquaint the reader with the TIMSS–R assessment. The second section focuses on the 23 nations that participated in TIMSS and TIMSS–R at the eighth-grade level, describing changes in mathematics and science achievement over the 4 intervening years. The third section compares the 17 nations that participated in fourth-grade TIMSS and eighth-grade TIMSS–R, examining changes in the relative standing of the U.S. 1995 fourth-graders and 1999 eighth-graders.

Chapter 3 focuses on the education-related contextual factors related to teaching and curriculum that were examined in TIMSS–R. The chapter is divided into four sections. The first section describes mathematics and science teacher preparation, qualifications, and ongoing professional development activities. The next section examines the curriculum in the participating nations, including the topics covered and emphasized in mathematics and science lessons. The third section provides information on classroom practices as reported by teachers and students. The chapter ends with a brief discussion of how much time eighth-grade students spend studying mathematics and science outside of school.

Chapter 4 discusses future directions that the analyses of TIMSS and TIMSS–R data could take. Several appendices are included in this report to provide additional information on the technical aspects of the study as well as more detailed information on the analyses presented in the main chapters of the report.

In addition to the text of this report, supplemental information is provided in the five appendices. Appendix 1 contains a selection of publications that have been produced in relation to TIMSS 1995. Appendix 2 discusses several technical aspects of the TIMSS and TIMSS–R studies. The tables in Appendices 3 and 4 provide additional information on the figures in Chapters 2 and 3, respectively. Lastly, Appendix 5 provides a supplemental table containing comparisons of mathematics and science achievement of the 54 nations that participated at the eighth-grade level in either TIMSS, TIMSS–R, or both studies.

CHAPTER 2

MATHEMATICS AND SCIENCE ACHIEVEMENT

KEY POINTS

In 1999, U.S. eighth-graders exceeded the international average in mathematics and science among the 38 participating nations.

Between 1995 and 1999, there was no change in eighth-grade mathematics or science achievement in the United States. Among the 22 other nations, there was no change in mathematics achievement for 18 nations, and no change in science achievement for 17 nations.

There was an increase in mathematics achievement among U.S. eighth-grade black students between 1995 and 1999. There was no change in science achievement for this group of students over the same period. U.S. eighth-grade white and Hispanic students showed no change in their mathematics or science achievement over the 4 years.

No differences in performance were found between U.S. eighth-grade girls and boys in mathematics in 1999, but boys outperformed girls in science.

The relative performance of the United States in mathematics and science was lower for eighth-graders in 1999 than it was for the cohort of fourth-graders 4 years earlier in 1995.

As indicated in the previous chapter, the primary intent of conducting TIMSS in 1995 and TIMSS–R in 1999 was to take the first step in measuring change in both achievement and educational context at the international level. This chapter describes the mathematics and science achievement of students in the participating nations. It is divided into three main sections, in the following order:

- findings for the 38 nations that participated in TIMSS–R;
- findings for the 23 nations that participated at the eighth grade in both TIMSS and TIMSS–R[1]; and
- findings for the 17 nations that participated at the fourth grade in TIMSS and eighth grade in TIMSS–R.

To assist the reader, the number of nations being compared in each analysis will be made explicit. This is important, as the number of nations included in the international average can vary depending on the frame of reference in the analysis.

What do the test scores mean?

TIMSS–R test scores are on a scale of 1 to 1,000, with a standard deviation of 100.[2] TIMSS–R test scores indicate where on the scale a group of students would fall. In general, the higher the score on TIMSS or TIMSS–R, the more items correctly answered by a larger percentage of a nation's students. The lower the score on TIMSS or TIMSS–R, the fewer items correctly answered by a larger percentage of a nation's students. TIMSS and TIMSS–R used item response theory to create the scale scores. The scales used in TIMSS and TIMSS–R account for differences in the difficulty of items and allow students' performance to be summarized on a common metric. The scales are thus a simplified method for making comparisons between nations. The scales measure achievement on mathematics and science items judged by international experts to be appropriate for eighth-grade students in the participating nations. Thus, higher performance indicates that students are more proficient at middle-school mathematics or science.

For all analyses presented in this report, differences between averages or percentages that are statistically significant are discussed using comparative terms such as "higher" and "lower." Differences that are not statistically significantly are discussed as "similar to" or "not different from" each other. To determine whether differences reported are statistically significant, two-tailed t-tests, at the .05 level, were used. Bonferroni adjustments are made when more than two groups are compared simultaneously (e.g., black, white, and Hispanic students).

The Mathematics and Science Achievement of Eighth-Graders in 1999

This section presents results for the 38 nations that participated in TIMSS–R in 1999.

National averages for mathematics and science from the 1999 TIMSS–R assessment are presented, beginning with figure 2. Though tempting, it is not correct to report U.S. scores by rank. This is because the process of estimating each nation's score from the sample of students who took the test produces only an estimate of the range within which the nation's real score lies. To conduct a fair comparison of the United States to other nations, nations are grouped according to whether their performance is higher than, not different from, or lower than the United States, given the margin of error for the survey. Nations with a national average higher than the U.S. average are indicated in the uppermost band of shading. Nations with a national average lower than the U.S. average are

[1]Twenty-six nations participated in TIMSS and TIMSS–R at the eighth grade. Of the 26 nations, 3 nations experienced significant irregularities in their participation in 1995: Israel, South Africa, and Thailand. Findings for the other 23 nations are reported here.

[2]Because the standard deviation is 100, raw differences between scores can be translated into effect sizes by dividing the raw difference by the standard deviation. For example, if the raw difference between the scores of two nations is 75, this translates to an effect size of 0.75 in TIMSS–R. The TIMSS–R scale was developed once a majority of nations had submitted data. At that time, the mean was set to 500, with a standard deviation of 100. Once the remaining data was submitted by nations, it was fitted to the developed scale, resulting in an actual mean slightly different than 500.

indicated in the lowermost band of shading. Nations with a national average not different from the U.S. average are shown unshaded and, for the most part, lie between these shaded areas. Note that the international average—the average of the national average scores for all nations combined—can be compared to the U.S. average in the same way as a national average and is shaded to indicate the significance of the difference.

Figure 2.—Average mathematics and science achievement of eighth-grade students, by nation: 1999

MATHEMATICS

Nation	Average
Singapore	604
Korea, Republic of	587
Chinese Taipei	585
Hong Kong SAR	582
Japan	579
Belgium-Flemish	558
Netherlands	540
Slovak Republic	534
Hungary	532
Canada	531
Slovenia	530
Russian Federation	526
Australia	525
Finland[1]	520
Czech Republic	520
Malaysia	519
Bulgaria	511
Latvia-LSS[2]	505
United States	502
England	496
New Zealand	491
Lithuania[3]	482
Italy	479
Cyprus	476
Romania	472
Moldova	469
Thailand	467
(Israel)	466
Tunisia	448
Macedonia, Republic of	447
Turkey	429
Jordan	428
Iran, Islamic Republic of	422
Indonesia	403
Chile	392
Philippines	345
Morocco	337
South Africa	275
International average of 38 nations	487

SCIENCE

Nation	Average
Chinese Taipei	569
Singapore	568
Hungary	552
Japan	550
Korea, Republic of	549
Netherlands	545
Australia	540
Czech Republic	539
England	538
Finland	535
Slovak Republic	535
Belgium-Flemish	535
Slovenia	533
Canada	533
Hong Kong SAR	530
Russian Federation	529
Bulgaria	518
United States	515
New Zealand	510
Latvia-LSS[2]	503
Italy	493
Malaysia	492
Lithuania[3]	488
Thailand	482
Romania	472
(Israel)	468
Cyprus	460
Moldova	459
Macedonia, Republic of	458
Jordan	450
Iran, Islamic Republic of	448
Indonesia	435
Turkey	433
Tunisia	430
Chile	420
Philippines	345
Morocco	323
South Africa	243
International average of 38 nations	488

Average is significantly higher than the U.S. average
Average does not differ significantly from the U.S. average
Average is significantly lower than the U.S. average

[1]The shading of Finland may appear incorrect; however, statistically, its placement is correct.

[2]Designated LSS because only Latvian-speaking schools were tested which represents 61 percent of the population.

[3]Lithuania tested the same cohort of students as other nations, but later in 1999, at the beginning of the next school year.

NOTE: Eighth grade in most nations. See appendix 2 for details.
Parentheses indicate nations not meeting international sampling and/or other guidelines. See appendix 2 for details.
The international average is the average of the national averages of the 38 nations.

SOURCE: Martin et al. (2000). *TIMSS 1999 International Science Report: Findings from IEA's Repeat of the Third International Mathematics and Science Study at the Eighth Grade.* Exhibit 1.1. Chestnut Hill, MA: Boston College; Mullis et al. (2000). *TIMSS 1999 International Mathematics Report: Findings from IEA's Repeat of the Third International Mathematics and Science Study at the Eighth Grade.* Exhibit 1.1. Chestnut Hill, MA: Boston College.

How well did U.S. eighth-graders perform in 1999?

In mathematics, U.S. eighth-graders exceeded the international average, outperforming their peers in 17 of the 37 other TIMSS–R nations, performing similarly to students in 6 nations, and performing lower than their peers in 14 nations. In 1999, the U.S. average score was 502, with other nations' average mathematics scores ranging from 604 for Singapore to 275 for South Africa. Among the top performing nations in 1999 were five Asian industrialized nations—Singapore, Korea, Chinese Taipei, Hong Kong SAR, and Japan. Comparisons with five of the Group of Eight (G8) nations are possible as well: in 1999, the United States performed significantly better in mathematics than Italy, performed similarly to England, but was outperformed by Japan, Canada, and the Russian Federation.[3]

In science, U.S. eighth-graders exceeded the international average, outperforming their peers in 18 of the 37 other nations, performing similarly to students in 5 nations, and performing lower than their peers in 14 nations. In 1999, the U.S. average score was 515, with other nations' average science scores ranging from 569 for Chinese Taipei to 243 for South Africa. Among the top performing nations in science were four Asian industrialized nations—Chinese Taipei, Singapore, Korea, and Japan—and Hungary. Comparisons with other participating G8 nations show that the United States performed significantly better than Italy, performed on par with the Russian Federation, but performed lower than Japan, England and Canada.

When looking across mathematics and science achievement in 1999, 12 nations outperformed the United States in both subjects: Australia, Belgium-Flemish, Canada, Chinese Taipei, Finland, Hungary, Japan, Korea, the Netherlands, Singapore, the Slovak Republic, and Slovenia. Likewise, three nations performed similarly to the United States in both subjects: Bulgaria, Latvia-LSS, and New Zealand. Finally, U.S. eighth-graders outperformed their peers in 17 nations across both mathematics and science in 1999.[4]

What percentage of our students scored at or above the international top 10 percent benchmark in 1999?

Average achievement scores indicate how the average student performs, but say little about the performance of the nation's students at different levels. International benchmarks were devised to provide a view of what proportion of a nation's students scored at or near various levels of achievement. These international benchmarks give a general indication of the relative distribution of scores within and across nations. For example, if a nation has a high average score and a large percentage of its students at or above the upper international benchmarks, this indicates that the nation's students are concentrated among the highest achieving students internationally.

TIMSS–R uses four benchmarks: the top 10 percent, the top 25 percent, the upper 50 percent, and the upper 75 percent. Each benchmark is based on all eighth-graders from all 38 nations in 1999. This report discusses two benchmarks in detail: the top 10 percent benchmark, which refers to the cutoff score that separates the top 10 percent of all students in 1999, and the similar top 25 percent benchmark. In 1999, the top 10 percent of all students scored 616 or higher in mathematics and 616 or higher in science (data not shown). The top 25 percent of all students scored 555 or higher in mathematics and 558 or higher in science (data not shown). Detailed information on these two benchmarks, as well as the upper 50 and upper 75 percent benchmarks, is found in tables A3.2 (mathematics) and A3.3 (science) in appendix 3.

[3]The United Kingdom, a member of the G8, is represented here by the score for England. France and Germany, the other two members of the G8, did not participate in TIMSS–R.

[4]An analysis of the overall mathematics and science achievement of the 54 nations that participated in TIMSS or TIMSS–R is provided in appendix 5.

In mathematics, 9 percent of U.S. eighth-graders scored 616 or higher, placing them among the top 10 percent of all eighth-graders in the 38 nations in 1999. This is a lower percentage of students than in 8 nations, a similar percentage as in 13 nations, and a higher percentage than in 16 nations (figure 3). In contrast, 46 percent of Singapore's eighth-grade students scored 616 or higher in mathematics in 1999. Among the five participating G8 nations, only Japan had a significantly higher percentage of students who scored at or above the international top 10 percent benchmark (33 percent) than the United States in mathematics.

Figure 3.—Percentages of eighth-grade students reaching the TIMSS-R 1999 top 10 percent in mathematics and science achievement, by nation: 1999

MATHEMATICS

Nation	Percent
Singapore	46
Chinese Taipei	41
Korea, Republic of	37
Hong Kong SAR	33
Japan	33
Belgium-Flemish	23
Hungary	16
Slovenia[1]	15
Russian Federation	15
Netherlands	14
Slovak Republic	14
Australia	12
Malaysia	12
Canada	12
Czech Republic	11
Bulgaria	11
United States	9
New Zealand	8
Latvia-LSS[2]	7
England	7
Finland	6
Romania	5
Italy[1]	5
(Israel)[1]	5
Thailand	4
Lithuania[3]	4
Moldova	4
Cyprus	3
Jordan	3
Macedonia, Republic of	3
Indonesia	2
Turkey	1
Iran, Islamic Republic of	1
Chile	1
Tunisia	0
South Africa	0
Philippines	0
Morocco	0

SCIENCE

Nation	Percent
Singapore	32
Chinese Taipei	31
Hungary	22
Korea, Republic of	22
England	19
Australia	19
Japan	19
Russian Federation	17
Czech Republic	17
Netherlands	16
Slovenia	16
United States	15
Finland	14
Slovak Republic	14
Bulgaria	14
Canada	14
New Zealand	12
Belgium-Flemish	11
Hong Kong SAR	10
Italy	7
Latvia-LSS[2]	7
(Israel)	7
Malaysia	6
Romania	6
Lithuania[3]	6
Jordan	4
Moldova	4
Macedonia, Republic of	4
Thailand	3
Cyprus	2
Iran, Islamic Republic of	2
Indonesia	1
Chile	1
Turkey	1
Philippines	1
South Africa	0
Tunisia	0
Morocco	0

Average is significantly higher than the U.S. average
Average does not differ significantly from the U.S. average
Average is significantly lower than the U.S. average

[1]The shading of Italy, Israel, and Slovenia in mathematics may appear incorrect; however, statistically, their placement is correct.

[2]Designated LSS because only Latvian-speaking schools were tested which represents 61 percent of the population.

[3]Lithuania tested the same cohort of students as other nations, but later in 1999, at the beginning of the next school year.

NOTE: Eighth grade in most nations. See appendix 2 for details.
Parentheses indicate nations not meeting international sampling and/or other guidelines. See appendix 2 for details.

SOURCE: Martin et al. (2000). *TIMSS 1999 International Science Report: Findings from IEA's Repeat of the Third International Mathematics and Science Study at the Eighth Grade.* Exhibit 1.6. Chestnut Hill, MA: Boston College; Mullis et al. (2000). *TIMSS 1999 International Mathematics Report: Findings from IEA's Repeat of the Third International Mathematics and Science Study at the Eighth Grade.* Exhibit 1.6. Chestnut Hill, MA: Boston College.

In science, 15 percent of U.S. eighth-graders scored 616 or higher, placing them among the top 10 percent of all students internationally in 1999. This was a lower percentage of students than in 4 nations, a similar percentage as in 13 nations, and a higher percentage than in 20 nations (figure 3). In contrast, 32 percent of Singapore's eighth-grade students scored 616 or higher in science in 1999. Among the five participating G8 nations, none had a significantly higher percentage of students who scored at or above the international top 10 percent benchmark than the United States in science.

What percentage of our students scored at or above the international top 25 percent benchmark in 1999?

An examination of the top 25 percent international benchmark offers yet another opportunity to understand the performance of our eighth-grade students in mathematics and science in 1999. In mathematics, 28 percent of U.S. eighth-grade students scored 555 or higher, placing them among the top 25 percent of all students internationally in 1999. This was a lower percentage than in 11 nations, a similar percentage as in 9 nations, and a higher percentage than in 17 nations. In contrast, 75 percent of eighth-grade students in Singapore scored 555 or higher in mathematics in 1999.

In science, 34 percent of U.S. eighth-graders scored 558 or higher, placing them among the top 25 percent of all students internationally in 1999. This was a lower percentage than in 5 nations, a similar percentage as in 13 nations, and a higher percentage than in 19 nations. In contrast, 58 percent of eighth-grade students in Chinese Taipei scored 558 or higher in science in 1999.

How well did U.S. eighth-graders perform in the different content areas in 1999?

An overall score is a useful summary of general mathematics and science performance. However, mathematics and science comprise a range of content areas that can be conceptually distinct, differ in levels of complexity, enter the curriculum at different times, and be taught by different teachers in separate courses. TIMSS–R assessed five mathematics and six science content areas:

Mathematics[5]

- ☐ Fractions and number sense
- ☐ Measurement
- ☐ Data representation, analysis, and probability
- ☐ Geometry
- ☐ Algebra

Science

- ☐ Earth science
- ☐ Life science
- ☐ Physics
- ☐ Chemistry
- ☐ Environmental and resource issues
- ☐ Scientific inquiry and the nature of science

U.S. eighth-graders' average score was higher than the international average in three of the five mathematics content areas assessed in 1999: *fractions and number sense*; *data representation, analysis, and probability*; and *algebra*. They performed at the international average in *measurement* and *geometry*.

Figure 4 displays mathematics content area scores for all 38 nations based on the TIMSS–R assessment. Six nations outperformed the United States across all five mathematics content areas in 1999: Belgium-Flemish, Chinese Taipei, Hong Kong SAR, Japan, Korea, and Singapore. New Zealand is the only nation in TIMSS–R that performed simiarly to the United States in all five content areas. Seven nations performed below the United States in all five mathematics content areas: Chile,

[5]TIMSS 1995 included *proportionality* among the mathematics content areas. After careful consideration, the *proportionality* items were redistributed among several of the other mathematics content areas for the TIMSS and TIMSS–R data.

Figure 4.—Average eighth-grade achievement in mathematics content areas, by nation: 1999

Fractions and number sense

Nation	Average
Singapore	608
Hong Kong SAR	579
Chinese Taipei	576
Korea, Republic of	570
Japan	570
Belgium-Flemish	557
Netherlands	545
Canada	533
Malaysia	532
Finland	531
Slovenia	527
Hungary	526
Slovak Republic	525
Australia	519
Russian Federation	513
United States	509
Czech Republic	507
Bulgaria	503
England	497
Latvia-LSS[1]	496
New Zealand	493
Cyprus	481
Lithuania[2]	479
(Israel)	472
Thailand	471
Italy	471
Moldova	465
Romania	458
Tunisia	443
Iran, Islamic Republic of	437
Macedonia, Republic of	437
Jordan	432
Turkey	430
Indonesia	406
Chile	403
Philippines	378
Morocco	335
South Africa	300
International average of 38 nations	487

Measurement

Nation	Average
Singapore	599
Korea, Republic of	571
Hong Kong SAR	567
Chinese Taipei	566
Japan	558
Belgium-Flemish	549
Hungary	538
Netherlands	538
Slovak Republic	537
Czech Republic	535
Australia	529
Russian Federation	527
Slovenia	523
Canada	521
Finland	521
Malaysia	514
England	507
Latvia-LSS[1]	505
Italy	501
Bulgaria	497
New Zealand	496
Romania	491
United States	482
Moldova	479
Cyprus	471
Lithuania[2]	467
Thailand	463
(Israel)	457
Macedonia, Republic of	451
Tunisia	442
Jordan	438
Turkey	436
Chile	412
Iran, Islamic Republic of	401
Indonesia	395
Philippines	355
Morocco	348
South Africa	329
International average of 38 nations	487

Data representation, analysis, and probability

Nation	Average
Korea, Republic of	576
Singapore	562
Chinese Taipei	559
Japan	555
Hong Kong SAR	547
Belgium-Flemish	544
Netherlands	538
Slovenia	530
Finland	525
Australia	522
Slovak Republic	521
Canada	521
Hungary	520
Czech Republic	513
England	506
United States	506
Russian Federation	501
New Zealand	497
Latvia-LSS[1]	495
Lithuania[2]	493
Bulgaria	493
Malaysia	491
Italy	484
Thailand	476
Cyprus	472
(Israel)	468
Romania	453
Moldova	450
Tunisia	446
Turkey	446
Macedonia, Republic of	442
Jordan	436
Iran, Islamic Republic of	430
Chile	429
Indonesia	423
Philippines	406
Morocco	383
South Africa	356
International average of 38 nations	487

Geometry

Nation	Average
Japan	575
Korea, Republic of	573
Singapore	560
Chinese Taipei	557
Hong Kong SAR	556
Belgium-Flemish	535
Slovak Republic	527
Bulgaria	524
Latvia-LSS[1]	522
Russian Federation	522
Netherlands	515
Czech Republic	513
Canada	507
Slovenia	506
Australia	497
Malaysia	497
Lithuania[2]	496
Finland	494
Hungary	489
Romania	487
Thailand	484
Cyprus	484
Tunisia	484
Italy	482
Moldova	481
New Zealand	478
United States	473
England	471
(Israel)	462
Macedonia, Republic of	460
Jordan	449
Iran, Islamic Republic of	447
Indonesia	441
Turkey	428
Chile	412
Morocco	407
Philippines	383
South Africa	335
International average of 38 nations	487

Algebra

Nation	Average
Chinese Taipei	586
Korea, Republic of	585
Singapore	576
Japan	569
Hong Kong SAR	569
Belgium-Flemish	540
Hungary	536
Russian Federation	529
Slovak Republic	525
Slovenia[3]	525
Canada[3]	525
Netherlands	522
Australia	520
Czech Republic	514
Bulgaria	512
United States	506
Malaysia	505
Latvia-LSS[1]	499
England	498
Finland	498
New Zealand	497
Lithuania[2]	487
Italy	481
Romania	481
(Israel)	479
Cyprus	479
Moldova	477
Macedonia, Republic of	465
Thailand	456
Tunisia	455
Jordan	439
Iran, Islamic Republic of	434
Turkey	432
Indonesia	424
Chile	399
Morocco	353
Philippines	345
South Africa	293
International average of 38 nations	487

Average is significantly higher than the U.S. average
Average does not differ significantly from the U.S. average
Average is significantly lower than the U.S. average

[1]Designated LSS because only Latvian-speaking schools were tested which represents 61 percent of the population.
[2]Lithuania tested the same cohort of students as other nations, but later in 1999, at the beginning of the next school year.
[3]The shading of Slovenia and Canada may appear incorrect; however, statistically, their placement is correct.

NOTE: Eighth grade in most nations. See appendix 2 for details.
Parentheses indicate nations not meeting international sampling and/or other guidelines. See appendix 2 for details.
The international average is the average of the national averages of the 38 nations.

SOURCE: Mullis et al. (2000). *TIMSS 1999 International Mathematics Report: Findings from IEA's Repeat of the Third International Mathematics and Science Study at the Eighth Grade.* Exhibit 3.1. Chestnut Hill, MA: Boston College.

Indonesia, Iran, Morocco, the Philippines, South Africa, and Turkey. *Geometry* and *measurement* are the content areas in which the United States performed lowest in terms of the number of nations that outperformed the United States, but the U.S. average was similar to the international average in both content areas.

In interpreting these results, it is important to consider the mathematics content areas and topics that students have likely encountered in the years leading up to and including eighth grade. For example, if students in the United States were not provided the opportunity to learn a particular mathematics topic or content area by the time of the assessment, it would be less likely that the students would perform well in comparison to their international peers in that area. Information on the coverage of mathematics content areas, as well as many other aspects of eighth-grade mathematics teaching and learning, is discussed in the next chapter.

U.S. eighth-graders' average score was higher than the international average in five of the six science content areas assessed in 1999: *earth science*; *life science*; *chemistry*; *environmental and resource issues*; and *scientific inquiry and the nature of science*. They performed at the international average of the 38 nations in *physics*.

Figure 5 displays science content area scores for the 38 TIMSS–R nations in 1999. As with mathematics, the international performance of nations differs when examining science by the six science content areas. The international performance of the United States is highest for *life science*; *environmental and resource issues*; and *scientific inquiry and the nature of science*. Only two nations scored higher than the United States in each of these three content areas. Chinese Taipei outperformed the United States in five of the six content areas, however. As in mathematics, New Zealand is the only nation that performed similarly to the United States across all six content areas in science. Finally, 12 nations performed below the United States in all six science content areas: Chile, Cyprus, Iran, Jordan, Macedonia, Moldova, Morocco, the Philippines, Romania, South Africa, Tunisia, and Turkey. *Physics* was the science content area that the United States performed lowest in terms of the number of nations that outperformed the United States, but the U.S. average was similar to the international average.

As with mathematics, it is important to understand the context within which science learning occurs when interpreting these results. This includes the science content areas and topics that students have likely encountered in their science lessons. Information on the coverage of the six science content areas, as well as many other aspects of eighth-grade science teaching and learning, is covered in the following chapter.

Figure 5.—Average eighth-grade achievement in science content areas, by nation: 1999

Earth science

Nation	Average
Hungary	560
Slovenia	541
Chinese Taipei	538
Slovak Republic	537
Netherlands	534
Japan	533
Belgium-Flemish	533
Czech Republic	533
Korea, Republic of	532
Russian Federation	529
England	525
Singapore	521
Finland	520
Bulgaria	520
Australia	519
Canada	519
Hong Kong SAR	506
New Zealand	504
United States	504
Italy	502
Latvia-LSS[1]	495
Malaysia	491
Lithuania[2]	476
Romania	475
(Israel)	472
Thailand	470
Moldova	466
Macedonia, Republic of	464
Cyprus	459
Iran, Islamic Republic of	459
Jordan	446
Tunisia	442
Chile	435
Turkey	435
Indonesia	431
Philippines	390
Morocco	363
South Africa	348
International average of 38 nations	488

Life science

Nation	Average
Chinese Taipei	550
Czech Republic	544
Singapore	541
Netherlands	536
Slovak Republic	535
Hungary	535
Belgium-Flemish	535
Japan	534
England	533
Australia	530
Korea, Republic of	528
Canada	523
Slovenia	521
Finland	520
United States	520
Russian Federation	517
Hong Kong SAR	516
Bulgaria	514
Latvia-LSS[1]	509
Thailand	508
New Zealand	501
Lithuania[2]	494
Italy	488
Malaysia	479
Moldova	477
Romania	475
Cyprus	468
Macedonia, Republic of	468
(Israel)	463
Jordan	448
Indonesia	448
Turkey	444
Tunisia	441
Iran, Islamic Republic of	437
Chile	431
Philippines	378
Morocco	347
South Africa	289
International average of 38 nations	488

Physics

Nation	Average
Singapore	570
Chinese Taipei	552
Japan	544
Korea, Republic of	544
Hungary	543
Netherlands	537
Australia	531
Belgium-Flemish	530
Russian Federation	529
England	528
Czech Republic	526
Slovenia	525
Hong Kong SAR	523
Canada	521
Finland	520
Slovak Republic	518
Lithuania[2]	510
Bulgaria	505
New Zealand	499
United States	498
Latvia-LSS[1]	495
Malaysia	494
(Israel)	484
Italy	480
Thailand	475
Romania	465
Macedonia, Republic of	463
Cyprus	459
Jordan	459
Moldova	457
Indonesia	452
Iran, Islamic Republic of	445
Turkey	441
Chile	428
Tunisia	425
Philippines	393
Morocco	352
South Africa	308
International average of 38 nations	488

Chemistry

Nation	Average
Chinese Taipei	563
Hungary	548
Singapore	545
Finland	535
Japan	530
Bulgaria	527
Slovak Republic	525
England	524
Korea, Republic of	523
Russian Federation	523
Canada	521
Australia	520
Hong Kong SAR	515
Netherlands	515
Czech Republic	512
Slovenia	509
United States	508
Belgium-Flemish	508
New Zealand	503
Italy	493
Latvia-LSS[1]	490
Iran, Islamic Republic of	487
Lithuania[2]	485
Malaysia	485
Jordan	483
Romania	481
Macedonia, Republic of	481
(Israel)	479
Cyprus	470
Moldova	451
Tunisia	439
Thailand	439
Turkey	437
Chile	435
Indonesia	425
Philippines	394
Morocco	372
South Africa	350
International average of 38 nations	488

Environmental and resource issues

Nation	Average
Singapore	577
Chinese Taipei	567
Australia	530
Netherlands	526
Korea, Republic of	523
Canada	521
Slovenia	519
Hong Kong SAR	518
England	518
Czech Republic	516
Finland	514
Belgium-Flemish	513
Slovak Republic	512
United States	509
Thailand	507
Japan	506
New Zealand	503
Malaysia	502
Hungary	501
Russian Federation	495
Latvia-LSS[1]	493
Italy	491
Indonesia	489
Bulgaria	483
Jordan	476
Cyprus	475
Romania	473
Iran, Islamic Republic of	470
Tunisia	462
Turkey	461
Lithuania[2]	458
(Israel)	458
Chile	449
Moldova	444
Macedonia, Republic of	432
Morocco	396
Philippines	391
South Africa	350
International average of 38 nations	488

Scientific inquiry and the nature of science

Nation	Average
Singapore	550
Korea, Republic of	545
Japan[3]	543
Chinese Taipei	540
England	538
Australia	535
Netherlands	534
Canada	532
Hong Kong SAR	531
Finland	528
Belgium-Flemish	526
Hungary	526
United States	522
Czech Republic	522
New Zealand	521
Slovenia	513
Slovak Republic	507
Latvia-LSS[1]	495
Russian Federation	491
Italy	489
Malaysia	488
Lithuania[2]	483
Bulgaria	479
(Israel)	476
Moldova	471
Cyprus	467
Macedonia, Republic of	464
Thailand	462
Romania	456
Tunisia	451
Iran, Islamic Republic of	446
Indonesia	446
Turkey	445
Chile	441
Jordan	440
Philippines	403
Morocco	391
South Africa	329
International average of 38 nations	488

Average is significantly higher than the U.S. average
Average does not differ significantly from the U.S. average
Average is significantly lower than the U.S. average

[1]Designated LSS because only Latvian-speaking schools were tested which represents 61 percent of the population.
[2]Lithuania tested the same cohort of students as other nations, but later in 1999, at the beginning of the next school year.
[3]The shading of Japan may appear incorrect; however, statistically, its placement is correct.

NOTE: Eighth grade in most nations. See appendix 2 for details.
Parentheses indicate nations not meeting international sampling and/or other guidelines. See appendix 2 for details.
The international average is the average of the national averages of the 38 nations.

SOURCE: Martin et al. (2000). *TIMSS 1999 International Science Report: Findings from IEA's Repeat of the Third International Mathematics and Science Study at the Eighth Grade.* Exhibit 3.1. Chestnut Hill, MA: Boston College.

What were students asked to do on the TIMSS–R assessment?

This section contains an example test item from each of the five mathematics and six science content areas assessed in 1999. Included are both multiple-choice and free-response item formats. Each example item is introduced with a brief description, the content area it represents, the correct answer or an example of a written response that was marked as correct, the U.S. percent correct, and the international average percent correct.

Information on the percent correct for each of the 38 TIMSS–R nations is provided in tables A3.6 (mathematics example items) and A3.7 (science example items) in appendix 3.

Figure 6 shows an example of a mathematics item that relates to *fractions and number sense*. This item asked students to choose the expression that best estimated the sum of two three-digit numbers using rounding. Ninety-three percent of U.S. students correctly chose B as the answer. The international average was 80 percent.

Figure 6.—Example mathematics item 1

The sum 691 + 208 is closest to the sum

A. 600 + 200

B. 700 + 200

C. 700 + 300

D. 900 + 200

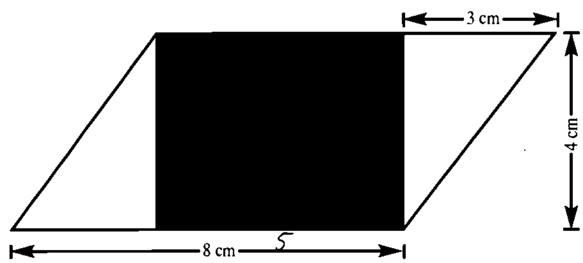
Correct answer: B U.S. percent correct: 93 International average: 80

SOURCE: Mullis et al. (2000). *TIMSS 1999 International Mathematics Report: Findings from IEA's Repeat of the Third International Mathematics and Science Study at the Eighth Grade.* Exhibit 2.18. Chestnut Hill, MA: Boston College.

In this example of a *measurement* item (figure 7), students were asked to find the area of a rectangle contained in a given parallelogram. Thirty-four percent of U.S. students correctly answered this item, while the international average was 43 percent.

Figure 7.—Example mathematics item 2

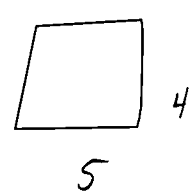
The figure shows a shaded rectangle inside a parallelogram.



What is the area of the shaded rectangle in square centimeters?

8-3 = 5

Answer: 20 cm



4 · 5 = 20

Correct answer: 20 cm^2 U.S. percent correct: 34 International average: 43

SOURCE: Mullis et al. (2000). *TIMSS 1999 International Mathematics Report: Findings from IEA's Repeat of the Third International Mathematics and Science Study at the Eighth Grade.* Exhibit 2.9. Chestnut Hill, MA: Boston College.

Figure 8 is an example of an item from the *data representation, analysis, and probability* content area. In this item, students were asked to determine which of the two magazines was less expensive, given the number of issues and cost of each issue. In order to receive full credit for this item, students had to calculate the cost of 24 issues for each magazine and arrive at the answer of Teen Life being 3 *ceds* less expensive than Teen News. In the United States, 26 percent of students received full credit for this item; the international average was 24 percent.

Figure 8.—Example mathematics item 3

Chris plans to order 24 issues of a magazine. He reads the following advertisements for two magazines. *Ceds* are the units of currency in Chris' country.

Teen Life Magazine	Teen News Magazine
24 issues First four issues FREE The remaining issues 3 *ceds* each.	24 issues First six issues FREE The remaining issues 3.5 *ceds* each.

Which magazine is the least expensive for 24 issues? How much less expensive? Show your work.

$$\begin{array}{r} 20 \\ \times\ 3 \\ \hline \$60 \end{array} \qquad \begin{array}{r} {}^{2\,4}18 \\ \times\ 3.5 \\ \hline .90 \\ +540 \\ \hline \$63.0 \end{array}$$

3 ceds cheaper

Correct answer: Teen Life, 3 ceds cheaper U.S. percent correct: 26 International average: 24

SOURCE: Mullis et al. (2000). *TIMSS 1999 International Mathematics Report: Findings from IEA's Repeat of the Third International Mathematics and Science Study at the Eighth Grade.* Exhibit 2.3. Chestnut Hill, MA: Boston College.

Figure 9 is an example of an item from the *geometry* content area. In this item, students were asked to determine the measure of the fourth angle of a quadrilateral, given the measurements of the other three (figure 9). In order to correctly answer this item, students needed the knowledge that the sum of the four angles of a quadrilateral always equals 360 degrees. Twenty percent of U.S. students answered this item correctly. The international average was 40 percent.

Figure 10, an *algebra* item, asked students to determine the number of girls and the number of boys in the fictitious club, given the total number of members and the information that there were 14 more girls than boys. Full credit was given if students gave the correct response of 36 boys and 50 girls and showed their work. Numerical, algebraic, and "guess and check" methods were all accepted for full credit. Twenty-nine percent of U.S. students received full credit on this item. The international average was 33 percent.

Figure 9.—Example mathematics item 4

In a quadrilateral, each of two angles has a measure of 115°. If the measure of a third angle is 70°, what is the measure of the remaining angle?

A. 60°

B. 70°

C. 130°

D. 140°

E. None of the above

Correct answer: A U.S. percent correct: 19 International average: 40

SOURCE: Boston College, International Study Center, Third International Mathematics and Science Study–Repeat (TIMSS–R), unpublished tabulations, 1999.

Figure 10.—Example mathematics item 5

A club has 86 members, and there are 14 more girls than boys. How many boys and how many girls are members of the club?

Show your work.

$$x+(14+x)=86$$
$$2x+14=86$$
$$2x+14-14=86-14$$
$$\frac{2x}{2}=\frac{72}{2}$$
$$x=36$$

$$86-36=50$$

There are 36 boys and 50 girls.

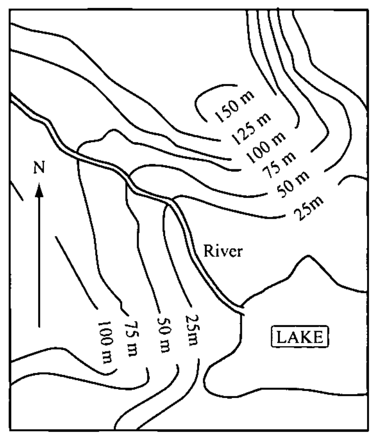
Correct answer: 36 boys and 50 girls U.S. percent correct: 29 International average: 33

SOURCE: Boston College, International Study Center, Third International Mathematics and Science Study–Repeat (TIMSS–R), unpublished tabulations, 1999.

Figure 11 is an example of an *earth science* item. This item asked students to read a contour map and determine which direction a river is flowing. In the U.S., 48 percent of students answered this item correctly; the international average was 37 percent.

Figure 11.—Example science item 1

On the diagram, hills and valleys are shown by means of contour lines. Each contour line indicates that all points on the line have the same elevation above sea level.



In which direction does the river flow?

A. Northeast

B. Southeast

C. Northwest

D. Southwest

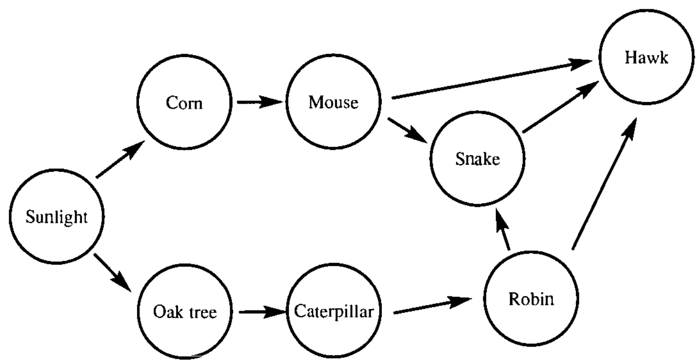
E. It is not possible to tell from the map.

Correct answer: B U.S. percent correct: 48 International average: 37

SOURCE: Boston College, International Study Center, Third International Mathematics and Science Study–Repeat (TIMSS–R), unpublished tabulations, 1999.

In this *life science* item, students were given a food web and asked to explain the effects of one part of the web on another part (figure 12). Specifically, they were asked to describe the consequences of crop failure on the population of robins. Several types of responses were given full credit. For example, students could have answered that the robin population would decrease due to predators eating more robins if mice die. They could have also answered that the robin population would increase based on predators dying due to lack of food (mice). Other feasible explanations, such as the robin population being unaffected because mice would find other sources of grain, were also given full credit.

Figure 12.—Example science item 2



Look at the food web above. If the corn crop failed one year what would most likely happen to the robin population? Explain your answer.

The population would go down because, the mice eat corn and if there is no corn for the mice to eat they will die and if the mice die the snake will have to eat more robins to stay alive.

U.S. percent correct: 35 International average: 26

SOURCE: Boston College, International Study Center, Third International Mathematics and Science Study–Repeat (TIMSS–R), unpublished tabulations, 1999.

Figure 13 shows an example of a science item that relates to *physics*. Given data on fuel consumption and work accomplished, students were asked to determine and explain which of two machines was more efficient by converting the information into common units or measures that could then be compared. Thirty percent of U.S. eighth-grade students answered both parts of this item correctly. The international average was 31 percent.

Figure 13.—Example science item 3

Machine A and Machine B are each used to pump water from a river. The table shows what volume of water each machine removed in one hour and how much gasoline each of them used.

	Volume of Water Removed in 1 Hour (liters)	Gasoline Used in 1 Hour (liters)
Machine A	1000	1.25
Machine B	500	0.5

a) Which machine is more efficient in converting the energy in gasoline to work?

Answer: B

b) Explain your answer:

1000 ÷ 1.25 = 800
500 ÷ .5 = 1000
Machine B is more efficient
because for every liter of gasoline
used it removed 1000L of water.
With 1L of gasoline Machine A
only removes 800L of water.

Correct answer: B U.S. percent correct: 30 International average: 31

SOURCE: Martin et al. (2000). *TIMSS 1999 International Science Report: Findings from IEA's Repeat of the Third International Mathematics and Science Study at the Eighth Grade.* Exhibit 2.3. Chestnut Hill, MA: Boston College.

Figure 14 shows an example of a science item that relates to *chemistry*. This item asked students to recall that when exposed to moisture and oxygen, iron rusts, and that painting the iron could prevent this reaction from happening. Sixty-six percent of U.S. eighth-grade students correctly answered this item. The international average was 67 percent.

In figure 15, an *environmental and resource issues* item, students were asked to choose the best explanation for why insecticides become ineffective over time. Sixty-two percent of U.S. students answered this item correctly; the international average was 48 percent.

Figure 14.—Example science item 4

Paint applied to an iron surface prevents the iron from rusting. Which ONE of the following provides the best reason?

A. It prevents nitrogen from coming in contact with the iron.

B. It reacts chemically with the iron.

C. It prevents carbon dioxide from coming in contact with the iron.

D. It makes the surface of the iron smoother.

E. It prevents oxygen and moisture from coming in contact with the iron.

Correct answer: E U.S. percent correct: 66 International average: 67

SOURCE: Martin et al. (2000). *TIMSS 1999 International Science Report: Findings from IEA's Repeat of the Third International Mathematics and Science Study at the Eighth Grade.* Exhibit 2.18. Chestnut Hill, MA: Boston College.

Figure 15.—Example science item 5

Insecticides are used to control insect populations so that they do not destroy the crops. Over time, some insecticides become less effective at killing insects, and new insecticidesmust be developed. What is the most likely reason insecticides become less effective over time?

A. Surviving insects have learned to include insecticides as a food source.

B. Surviving insects pass their resistance to insecticides to their offspring.

C. Insecticides build up in the soil.

D. Insecticides are concentrated at the bottom of the food chain.

Correct answer: B U.S. percent correct: 62 International average: 48

SOURCE: Martin et al. (2000). *TIMSS 1999 International Science Report: Findings from IEA's Repeat of the Third International Mathematics and Science Study at the Eighth Grade.* Exhibit 2.13. Chestnut Hill, MA: Boston College.

Figure 16 is an example of an item that relates to *scientific inquiry and the nature of science.* In this item, students were asked to describe a procedure that could be used to determine the time it takes for a person's heart rate to return to normal after exercising. They were also asked to list the materials needed for their procedure. In order to receive full credit, students needed to include all of the following: somebody (or self) measuring "normal" pulse rate with a timer or watch; having the subject exercise; and measuring the time interval between the completion of exercise and the pulse rate returning to "normal." Twenty-one percent of U.S. students answered this item correctly. The international average was 12 percent.

Figure 16.—Example science item 6

Suppose you want to investigate how long it takes for the heart rate to return to normal after exercising. What materials would you use and what procedures would you follow?

Materials

Stop watch

procedure

1. check heart rate
2. exercise
3. stop exercising, begin timing
4. check heart rate. when heart rate returns to original rate, stop timing.

U.S. percent correct: 21 International average: 12

SOURCE: Boston College, International Study Center, Third International Mathematics and Science Study–Repeat (TIMSS–R), unpublished tabulations, 1999.

How did different groups of students within the United States perform?

Comparisons of U.S. population group performance are common in the literature on student achievement, especially comparisons by sex and race/ethnicity. The *Condition of Education* (NCES 2000b), the *Digest of Education Statistics* (NCES 1999), *Science and Engineering Indicators–2000* (National Science Board 2000), and the various reports associated with each NAEP assessment (e.g., NCES 1997a, 1997b, and 2000c) routinely provide comparisons of the achievement of selected population groups.

Population groups tend to be defined by demographic attributes such as sex, race/ethnicity, language, and the like. Interest in the comparative performance of population groups reflects a concern that all students—regardless of race, ethnicity, sex, or family background, among other things—receive equitable educational opportunities. A national average score cannot describe the range of achievement within a nation and whether patterns of performance are associated with different subgroups.

The analyses that follow focus on five categories of population groups in the United States; these groups are defined by: sex, race/ethnicity, national origin of parents, level of parental education, and type of school attended.[6] These analyses examine the relationship between specific group characteristics and achievement. These are preliminary analyses of the data from TIMSS–R. Future analyses will examine the same relationships while accounting for other factors.

Figure 17 shows the average mathematics and science performance for the population groups noted above. The results of testing the statistical significance of the difference between group averages are described to the right of the group averages.[7]

Was there a difference in the mathematics and science achievement of U.S. eighth-grade boys and girls?

In mathematics, there was no evidence of a difference in achievement between U.S. eighth-grade boys and girls in 1999. The average score for girls was similar to the average score for boys. Of the other nations in 1999, only four—the Czech Republic, Iran, Israel, and Tunisia—showed differences in the achievement of boys and girls in mathematics, all in favor of boys (see table A3.9, appendix 3 for details).

In science, U.S. eighth-grade boys outperformed eighth-grade girls in 1999. In all, the United States and 15 other nations showed differences between the average achievement of boys and girls, and all differences favored boys.[8] Twenty-two nations showed no differences between boys and girls in science. In addition to the United States, Canada, Chile, Chinese Taipei, the Czech Republic, England, Hungary, Iran, Korea, Latvia-LSS, Lithuania, the Netherlands, Russian Federation, Slovak Republic, Slovenia, and Tunisia showed differences in science achievement between boys and girls (see table A3.9, appendix 3).

The TIMSS–R findings in mathematics are consistent with other studies conducted at this grade level, such as NAEP (NCES, 1997a, 2000c). The TIMSS–R findings for the United States in science differ from the most recent results for NAEP and long term trend NAEP (NCES, 1997b, 2000c) where no difference in science achievement was found between eighth-grade boys and girls. Reasons for the different results in TIMSS–R and NAEP may relate to the differences in the science topics and content areas emphasized in the two assessment frameworks and the relationship of the frameworks to U.S. science curricula through the eighth grade. Differences and similarities between

[6] Data are analyzed based on students' reports of sex, race/ethnicity, national origin of parents, and level of parental education. Data on type of school attended based on school sample.

[7] Other factors are not controlled for in these analyses.

[8] Readers may recall that there was no difference found in TIMSS 1995 between the science performance of U.S. eighth-grade boys and girls (NCES 1996). As a result of rescaling the TIMSS data, the data show that U.S. eighth-grade boys outperformed girls in science in 1995.

Figure 17.—U.S. eighth-grade mathematics and science achievement, by selected characteristics: 1999

Characteristics	Mathematics average	Science average	Significance
Sex			
Boys	505	524	Boys and girls performed similarly in mathematics. Boys outperformed girls in science.
Girls	498	505	
Race/ethnicity			
White students	525	547	White students outperformed black and Hispanic students in mathematics and science. Black and Hispanic students performed similarly to each other in mathematics. Hispanic students outperformed black students in science.
Black students	444	438	
Hispanic students	457	462	
Public/nonpublic school			
Public school students	498	510	Nonpublic school students outperformed public school students in mathematics and science.
Nonpublic school students	526	548	
National origin of parents			
Both U.S. born	510	527	In mathematics and science, students whose parents were both U.S. born outperformed students whose parents were both foreign born. In mathematics and science, students whose parents were both U.S. born and students with one U.S. born parent and one foreign born parent performed similarly. In science, students with one U.S. born parent and one foreign born parent outperformed students whose parents were both foreign born.
Both foreign born	477	472	
1 U.S. born, 1 foreign born	496	509	
Mother's education			
High school or less	484	499	In mathematics and science, students whose mothers completed college outperformed students whose mothers completed high school or less. In mathematics and science, students whose mothers completed college outperformed students whose mothers attended some college. In mathematics and science, students whose mothers attended some college outperformed students whose mothers completed high school or less.
Some college	511	525	
Completed college	539	554	
Father's education			
High school or less	482	495	In mathematics and science, students whose fathers completed college outperformed students whose fathers completed high school or less. In mathematics and science, students whose fathers completed college outperformed students whose fathers attended some college. In mathematics and science, students whose fathers attended some college outperformed students whose fathers completed high school or less.
Some college	512	529	
Completed college	543	560	

NOTE: Other factors are not controlled for in these analyses.

SOURCE: U.S. Department of Education, National Center for Education Statistics, Third International Mathematics and Science Study–Repeat (TIMSS–R), unpublished tabluations, 1999.

TIMSS–R and NAEP, as well as PISA, are discussed in chapter 1. A more thorough analysis of TIMSS–R science data for U.S. boys and girls may reveal important insights into the differences noted here.

Did the achievement of U.S. students differ by race and ethnicity?

Studies have regularly shown that white students outperform the two largest minority groups in the United States—namely, black students and Hispanic students—in mathematics and science. TIMSS-R results and other large-scale studies, such as NAEP (NCES 1997a, 1997b, and 2000c), present a similar picture of the achievement of eighth-grade white students, black students, and Hispanic students in the United States. In 1999, the average score for white students was higher than for either black students or Hispanic students in mathematics. Black students and Hispanic students performed similarly (see figure 17).

In science, the average 1999 score for U.S. eighth-grade white students was higher than for either black students or Hispanic students, and Hispanic students outperformed black students (see figure 17). The research literature offers several explanations for differences in the performance of particular populations, generally suggesting that various forms of inequality of opportunity result in differences in achievement (Wilson 1987 and 1996; Jencks and Phillips 1998). These possible explanations are not explored in the analyses presented here.

Did the achievement of students in U.S. public and nonpublic schools differ?

In both mathematics and science in 1999, the average achievement score of U.S. eighth-grade nonpublic school students was higher than the average of their peers in U.S. public schools (figure 17).[9] Competing explanations for differences in the achievement of public and nonpublic students in the United States are found in the research literature. One possible explanation is that the two types of schools differ in the quality of the education offered to students (Coleman, Hoffer, and Kilgore 1981, 1982). The rationale here is that higher quality offerings lead to higher achievement. Another possible explanation offered in the literature is that differences in achievement between public and nonpublic school students are the result of differences in the socioeconomic status of the students recruited into each type of school (Jimenez and Lockheed 1991). The rationale behind this argument is that different opportunities for learning are created or nurtured among students from different socioeconomic backgrounds. The findings for public and nonpublic students from TIMSS–R are consistent with findings from NAEP (NCES 1997a, 1997b, and 2000c). Indeed, in nations with sizable numbers of nonpublic schools (e.g., Australia, the United Kingdom, and the United States), on average, students who attended nonpublic schools did better than those who attended public schools (Coleman, Hoffer, and Kilgore 1982; Williams and Carpenter 1990; Halsey, Heath, and Ridge 1984). The analyses presented here do not offer any possible explanation for the observed differences; rather, the analyses simply document achievement differences between eighth-grade students in these two types of schools. More thorough analysis of the data, taking into account such factors as race/ethnicity or socioeconomic status, may reveal important insights into possible reasons for the observed differences.

Did the achievement of U.S. students of different national origins differ?

TIMSS–R asked students to indicate whether their parents were U.S. or foreign-born. There is an interest in the birthplace of students' parents because a sizeable proportion of students with parents born outside the United States may not speak English as their first language or may not speak English at home with great frequency, if at all. Since English is generally the language of

[9]Forty-four of the 221 schools sampled in the United States were nonpublic schools. Among these 44 nonpublic schools, 26 were Catholic, 13 were Protestant/other religious, 4 were non-religious independent schools, and 1 was unspecified.

instruction in U.S. classrooms, students' facility with language may play a role in their ability to adequately understand school subjects. Moreover, immigrant status is often associated with lower socioeconomic status and more limited educational opportunities. The average 1999 mathematics score of eighth-grade students whose parents were both foreign-born was lower than the score of students whose parents were both U.S. born (figure 17). In science in 1999, the average score of eighth-graders whose parents were both foreign-born was lower than the score of students with at least one parent born in the United States.

Did the achievement of U.S. students differ by the level of their parents' education?

The average mathematics performance of eighth-grade students in 1999 differed by their parents' level of education. Students who reported that their parents had completed college had a higher average score in mathematics than students who reported that their parents completed some college and, in turn, these students had a higher score than students whose parents had no more than a high school education (figure 17).

The pattern in science is similar to mathematics in 1999. As the level of parental education rises, so do the test scores of students. On average, in science, eighth-grade students whose parents had completed college outperformed students whose parents had attended some college and these students, in turn, outperformed students whose parents had no more than a high school education (figure 17).

The TIMSS–R results indicate that as parental education levels increased so did the mathematics and science performance of U.S. eighth-grade students. The relationship between level of parental education and the educational achievement of children is well-documented (Sewell, Hauser, and Wolf 1976; Featherman 1981; Riordan 1997; NCES 1997a and 1997b).

The Mathematics and Science Achievement of Eighth-Graders Between 1995 and 1999

This section presents results for the 23 nations with comparable data that participated at the eighth grade in both TIMSS and TIMSS–R.[10] To compare the performance of eighth-grade students on TIMSS and TIMSS–R, both eighth-grade assessments used the same scale.[11]

Did the performance of U.S. eighth-graders change between 1995 and 1999?

For the 23 nations that participated in both TIMSS and TIMSS–R, there was little change in mathematics average scores over the 4-year period. There was no change in eighth-grade mathematics achievement between 1995 and 1999 in the United States as well as 18 other nations (figure 18).[12] Three nations—Canada, Cyprus, and Latvia-LSS—showed an increase in overall mathematics achievement between 1995 and 1999. One nation, the Czech Republic, experienced a decrease in overall achievement over the

[10]Twenty-six nations participated in TIMSS and TIMSS–R at the eighth grade. Of the 26 nations, 3 nations experienced significant irregularities in their participation in 1995: Israel, South Africa, and Thailand. Findings for the other 23 nations are reported here. Results for the 3 nations that experienced irregularities are provided in appendix 3, tables A3.10 and A3.11.

[11]The national averages presented here for the TIMSS grade 8 assessment differ a little from the averages appearing in previous TIMSS reports published over the past several years. This is a result of rescaling the TIMSS 1995 grade 8 data to allow for reliable comparisons to the TIMSS–R 1999 grade 8 data.

[12]The finding that there has been no change in the overall mathematics score from 1995, when the United States performed at the international average, to 1999, when the United States performed above the international average, may appear to be inconsistent. However, readers are cautioned from drawing conclusions based on the relative position of the United States in comparison to the international average for all 42 nations in 1995 and all 38 nations in 1999. A more accurate analysis of change in achievement over the 4 years is the one presented above: a comparison between only the 23 nations that participated in both 1995 and 1999, and the international average of scores for these nations.

same period.[13] The reader is cautioned against comparing the relative change in one nation to the relative change in another nation.

In the United States and 17 other nations, there was no change in the science achievement score of eighth-graders between 1995 and 1999. Four nations documented an increase in science

Figure 18.—Comparisons of eighth-grade mathematics achievement, by nation: 1995 and 1999

Nation	1995 average	1999 average	1995–1999 difference[3]
(Latvia-LSS)[1]	488	505	17 △
Canada	521	531	10 △
Cyprus	468	476	9 △
Hong Kong SAR	569	582	13 ○
(Netherlands)	529	540	11 ○
(Lithuania)[2]	472	482	10 ○
United States	492	502	9 ○
Belgium-Flemish	550	558	8 ○
Korea, Republic of	581	587	6 ○
(Australia)	519	525	6 ○
Hungary	527	532	5 ○
Iran, Islamic Republic of	418	422	4 ○
Russian Federation	524	526	2 ○
Slovak Republic	534	534	0 ○
(Slovenia)	531	530	-1 ○
(Romania)	474	472	-1 ○
(England)	498	496	-1 ○
Japan	581	579	-2 ○
Singapore	609	604	-4 ○
Italy	491	485	-6 ○
New Zealand	501	491	-10 ○
(Bulgaria)	527	511	-16 ○
Czech Republic	546	520	-26 ▽
International average of 23 nations	519	521	2 ○

△ The 1999 average is significantly higher than the 1995 average
○ The 1999 average does not differ significantly from the 1995 average
▽ The 1999 average is significantly lower than the 1995 average

[1]Designated LSS because only Latvian-speaking schools were tested.

[2]Lithuania tested the same cohort of students as other nations, but later in 1999, at the beginning of the next school year.

[3]Difference is calculated by subtracting the 1995 score from the 1999 score. Detail may not sum to totals due to rounding.

NOTE: Eighth grade in most nations. See appendix 2 for details.
Parentheses indicate nations not meeting international sampling and/or other guidelines in 1995, 1999, or both years. See appendix 2 for details regarding 1999 data. See NCES (1996) for details for 1995 data.
The international average is the average of the national averages of the 23 nations with approved sampling procedures.
The tests for significance take into account the standard error for the reported differences. Thus, a small difference between the 1995 and 1999 averages for one nation may be significant while a large difference for another nation may not be significant.
The 1995 scores are based on re-scaled data.

SOURCE: Mullis et al. (2000). *TIMSS 1999 International Mathematics Report: Findings from IEA's Repeat of the Third International Mathematics and Science Study at the Eighth Grade.* Exhibit 1.3. Chestnut Hill, MA: Boston College.

[13]In a separate analysis of just those 48 mathematics items (out of 155) in common between TIMSS and TIMSS–R, the same picture of overall eighth-grade mathematics achievement emerges. Results of this separate analysis revealed that 3 nations—Canada, Cyprus, and Latvia-LSS—experienced increases in their mathematics performance over the 4 years on the in-common items. One nation, the Czech Republic, experienced a decrease in its mathematics performance over the same period of time. The remaining 19 nations, including the United States, experienced no change in overall mathematics achievement on the set of 48 in-common items between TIMSS and TIMSS–R.

achievement between 1995 and 1999: Canada, Hungary, Latvia-LSS, and Lithuania (figure 19). One nation, Bulgaria, showed a decline in science over the 4 years.[14] Again, the reader is cautioned against comparing the relative change in one nation to the relative change in another nation.

Figure 19.—Comparisons of eighth-grade science achievement, by nation: 1995 and 1999

Nation	1995 average	1999 average	1995–1999 difference[3]
(Latvia-LSS)[1]	476	503	27 ▵
(Lithuania)[2]	464	488	25 ▵
Canada	514	533	19 ▵
Hungary	537	552	16 ▵
Hong Kong SAR	510	530	20 ○
(Australia)	527	540	14 ○
Cyprus	452	460	8 ○
Russian Federation	523	529	7 ○
(England)	533	538	5 ○
(Netherlands)	541	545	3 ○
Slovak Republic	532	535	3 ○
Korea, Republic of	546	549	3 ○
United States	513	515	2 ○
Belgium-Flemish	533	535	2 ○
(Romania)	471	472	1 ○
Italy	497	498	1 ○
New Zealand	511	510	-1 ○
Japan	554	550	-5 ○
(Slovenia)	541	533	-8 ○
Singapore	580	568	-12 ○
Iran, Islamic Republic of	463	448	-15 ○
Czech Republic	555	539	-16 ○
(Bulgaria)	545	518	-27 ▿
International average of 23 nations	518	521	3 ○

▵ The 1999 average is significantly higher than the 1995 average
○ The 1999 average does not differ significantly from the 1995 average
▿ The 1999 average is significantly lower than the 1995 average

[1]Designated LSS because only Latvian-speaking schools were tested.

[2]Lithuania tested the same cohort of students as other nations, but later in 1999, at the beginning of the next school year.

[3]Difference is calculated by subtracting the 1995 score from the 1999 score. Detail may not sum to totals due to rounding.

NOTE: Eighth grade in most nations. See appendix 2 for details.
Parentheses indicate nations not meeting international sampling and/or other guidelines in 1995, 1999, or both years. See appendix 2 for details regarding 1999 data. See NCES (1996) for details for 1995 data.
The international average is the average of the national averages of the 23 nations with approved sampling procedures.

The tests for significance take into account the standard error for the reported differences. Thus, a small difference between the 1995 and 1999 averages for one nation may be significant while a large difference for another nation may not be significant.

The 1995 scores are based on re-scaled data.

SOURCE: Martin et al. (2000). *TIMSS 1999 International Science Report: Findings from IEA's Repeat of the Third International Mathematics and Science Study at the Eighth Grade.* Exhibit 1.3. Chestnut Hill, MA: Boston College.

[14]In a separate analysis of just those 48 science items (out of 143) in common between TIMSS and TIMSS–R, a similar picture of overall eighth-grade science achievement emerges. Results of this separate analysis revealed that 3 nations—Canada, Hungary, and Latvia-LSS—experienced increases in science performance over the 4 years on the in-common items. The remaining 20 nations—including the United States—experienced no change in overall mathematics achievement on the set of 48 in-common items between TIMSS and TIMSS–R.

In sum, eighth-grade mathematics and science scores in the United States showed no changes between 1995 and 1999. The lack of change in national averages over a relatively short period of 4 years may indicate that longer periods of monitoring achievement may be necessary to detect change. It may also indicate that change efforts implemented at the local level may not yet be impacting achievement measured at the national level. Of course, careful consideration of TIMSS and TIMSS–R data as well as other data on the teaching and learning of mathematics and science in middle school is needed to better address the possible reasons why change was not evident over the 4 years.

Did the percentage of U.S. students at or above the international top 10 percent benchmark change over the 4 years?

As was discussed earlier in this chapter, average achievement scores indicate how the average student performs, but reveal little about the performance of a nation's top students. The following analyses document changes in the percentages of students who scored at or above the international top 10 percent and top 25 percent benchmarks. Detailed information on changes in these two international benchmarks is provided in tables A3.12 (mathematics) and A3.13 (science) in appendix 3.

The percentage of U.S. eighth-graders who scored at or above the international top 10 percent benchmark of students in mathematics showed no change between 1995 and 1999. None of the other 22 nations documented a change either. The 1999 top 10 percent cut-off score was 616 in mathematics. Applied to the 1995 TIMSS data, 6 percent of U.S. eighth-graders scored 616 or higher in mathematics in 1995, placing them among the top 10 percent of all students internationally.[15] In 1999, this percentage was 9 percent (figure 20).

[15]Readers may note that previous reports on TIMSS indicated that 5 percent of U.S. eighth-grade students were included among all students internationally who scored at or above the international top 10 percent benchmark in mathematics, whereas the percentage reported here is 6 percent. This difference is due to the way that the percentage of students in mathematics in 1995 is calculated for comparative purposes. To compare the percentage of students who scored at or above the international top 10 percent benchmark in mathematics in 1995 to those in 1999, the score point used to determine the top 10 percent in 1999 was also applied to the 1995 data. This, of course, was not the case when the data was initially reported for TIMSS. This procedure was applied to the science data as well.

Figure 20.—Comparisons of percentages of eighth-grade mathematics students reaching the TIMSS-R 1999 top 10 percent in mathematics achievement, by nation: 1995 and 1999

Nation	1995 percentage of students	1999 percentage of students	1995–1999 difference[3]
Hong Kong SAR	28	33	5 ○
Belgium-Flemish	19	23	4 ○
Canada	9	12	3 ○
United States	6	9	3 ○
Hungary	13	16	3 ○
(Latvia-LSS)[1]	5	7	3 ○
(Netherlands)	12	14	3 ○
(Slovenia)	13	15	2 ○
Russian Federation	12	15	2 ○
Korea, Republic of	36	37	2 ○
(Australia)	11	12	1 ○
(Lithuania)[2]	3	4	1 ○
Iran, Islamic Republic of	0	1	0 ○
(Romania)	5	5	0 ○
Singapore	46	46	0 ○
(England)	8	7	0 ○
New Zealand	8	8	0 ○
Japan	34	33	0 ○
Cyprus	4	3	-1 ○
Slovak Republic	14	14	-1 ○
Italy	7	6	-1 ○
Czech Republic	19	11	-8 ○
(Bulgaria)	19	11	-8 ○
International average of 23 nations	14	15	1 ○

△ The 1999 average is significantly higher than the 1995 average
○ The 1999 average does not differ significantly from the 1995 average
▽ The 1999 average is significantly lower than the 1995 average

[1]Designated LSS because only Latvian-speaking schools were tested.

[2]Lithuania tested the same cohort of students as other nations, but later in 1999, at the beginning of the next school year.

[3]Difference is calculated by subtracting the 1995 score from the 1999 score. Detail may not sum to totals due to rounding.

NOTE: Eighth grade in most nations. See appendix 2 for details.
Parentheses indicate nations not meeting international sampling and/or other guidelines in 1995, 1999, or both years. See appendix 2 for details regarding 1999 data. See NCES (1996) for details for 1995 data.
The international average is the average of the national averages of the 23 nations with approved sampling procedures.
1995 scores are based on re-scaled data.
1995 percentage of students reaching the top 10 percent is based on 1999 top 10 percent calculations.
SOURCE: Mullis et al. (2000). *TIMSS 1999 International Mathematics Report: Findings from IEA's Repeat of the Third International Mathematics and Science Study at the Eighth Grade.* Exhibit 1.7. Chestnut Hill, MA: Boston College.

As in mathematics, the percentage of U.S. eighth-graders who scored at or above the international top 10 percent benchmark of students in science showed no change between 1995 and 1999. The 1999 top 10 percent cut-off score was 616 in science. Applied to the 1995 TIMSS data, 13 percent of U.S. eighth-graders scored 616 or higher in science in 1995, placing them among the top 10 percent of all students internationally. In 1999, this percentage was 15 percent (figure 21). Among the 22 other nations that participated in TIMSS and TIMSS-R at the eighth-grade level, only 2 nations showed a change in the proportion of students scoring at or above the international top 10 percent benchmark over the same four-year period: Hungary documented an increase while Bulgaria documented a decrease.

Figure 21.—Comparisons of percentages of eighth-grade science students reaching the TIMSS–R 1999 top 10 percent in science achievement, by nation: 1995 and 1999

Nation	1995 percentage of students	1999 percentage of students	1995–1999 difference[3]
Hungary	14	22	8 △
Russian Federation	13	17	4 ○
Canada	11	14	3 ○
(Latvia-LSS)[1]	4	7	3 ○
(Lithuania)[2]	3	6	3 ○
(Australia)	17	19	3 ○
(England)	17	19	2 ○
United States	13	15	2 ○
Korea, Republic of	20	22	2 ○
(Netherlands)	15	16	1 ○
Italy	7	8	1 ○
Hong Kong SAR	9	10	1 ○
Iran, Islamic Republic of	2	2	0 ○
New Zealand	11	12	0 ○
(Romania)	6	6	0 ○
(Slovenia)	16	16	0 ○
Cyprus	3	2	0 ○
Slovak Republic	15	14	0 ○
Belgium-Flemish	12	11	-1 ○
Singapore	33	32	-1 ○
Japan	21	19	-2 ○
Czech Republic	21	17	-4 ○
(Bulgaria)	24	14	-10 ▽
International average of 23 nations	13	14	1 ○

△ The 1999 average is significantly higher than the 1995 average

○ The 1999 average does not differ significantly from the 1995 average

▽ The 1999 average is significantly lower than the 1995 average

[1]Designated LSS because only Latvian-speaking schools were tested.

[2]Lithuania tested the same cohort of students as other nations, but later in 1999, at the beginning of the next school year.

[3]Difference is calculated by subtracting the 1995 score from the 1999 score. Detail may not sum to totals due to rounding.

NOTE: Eighth grade in most nations. See appendix 2 for details.
Parentheses indicate nations not meeting international sampling and/or other guidelines in 1995, 1999, or both years. See appendix 2 for details regarding 1999 data. See NCES (1996) for details for 1995 data.
The international average is the average of the national averages of the 23 nations with approved sampling procedures.
1995 scores are based on re-scaled data.
1995 percentage of students reaching the top 10 percent is based on 1999 top 10 percent calculations.

SOURCE: Martin et al. (2000). *TIMSS 1999 International Science Report: Findings from IEA's Repeat of the Third International Mathematics and Science Study at the Eighth Grade.* Exhibit 1.7. Chestnut Hill, MA: Boston College.

Did the percentage of U.S. students at or above the international top 25 percent benchmark change over the 4 years?

The percentage of U.S. eighth-graders who scored at or above the international top 25 percent benchmark of students in mathematics showed no change between 1995 and 1999. The 1999 international top 25 percent cut-off score was 555 in mathematics. Applied to the 1995 TIMSS data, 24 percent of U.S. eighth-graders scored 555 or higher in mathematics in 1995, placing them among the top 25 percent of all students internationally.[16] In 1999, this percentage was 28 percent. Only one nation showed a change in the percentage of its students who scored at or above the international top 25 benchmark over this same period of time—the Czech Republic documented a decrease.

The percentage of U.S. eighth-graders who scored at or above the international top 25 percent benchmark of students in science showed no change between 1995 and 1999. The 1999 international top 25 percent cut-off score was 558 in science. Applied to the 1995 TIMSS data, 34 percent of U.S. eighth-graders scored 558 or higher in science in 1995, placing them among the top 25 percent of all students internationally. In 1999, this percentage was also 34 percent. Four nations—Canada, Hungary, Latvia-LSS, and Lithuania—showed an increase in the percentage of students who scored at or above the international top 25 benchmark over this same period of time.

Did the performance of U.S. eighth-graders in the content areas change between 1995 and 1999?

Comparisons of performance on the mathematics and science content areas can be made among the 23 nations that participated in TIMSS and TIMSS–R at the eighth-grade level. Detailed information on changes in performance in the mathematics and science content areas between 1995 and 1999 is provided in tables A3.14 and A3.15 in appendix 3.

In the five mathematics content areas in common between TIMSS and TIMSS–R, there was no change in the performance of U.S. eighth-graders nor of their peers in most of the other 22 nations. However, Canada and Latvia-LSS documented increases in performance in four of the five mathematics content areas over the 4-year period: *fractions and number sense*; *data representation, analysis and probability*; *geometry*; and *algebra*. No nation showed a change in the performance of its students in *measurement*. On the other hand, the Czech Republic showed a decrease in three content areas: *fractions and number sense*; *geometry*; and *algebra*. The only other nation to show a decrease over the four years was Bulgaria in the area of *data representation, analysis, and probability*.

In the four science content areas in common between TIMSS and TIMSS–R,[17] there was no change in the performance of U.S. eighth-graders nor of their peers in most of the other 22 nations. Only one nation, Canada, recorded an increase in the performance of its eighth-graders in all four science content areas over the 4 years. Hungary and Latvia-LSS showed increases in the performance of their students in two of the four science content areas. The Czech Republic and Slovak Republic experienced decreases in *physics* over the same four years, and Slovenia documented a decrease in *earth science*.

[16] To compare the percentage of students who scored at or above the international top 25 percent benchmarks in mathematics and science in 1995 to those in 1999, the score point used to determine the top 25 percent in 1999 was also applied to the 1995 data.

[17] The TIMSS–R science assessment reflects the inclusion of 10 new items in the areas of *environmental and resource issues*, and *scientific inquiry and the nature of science*. In TIMSS, these areas were reported as a single content area. Therefore, there are four science content areas in common between the two studies that can be reported.

Did the performance of U.S. population groups change between 1995 and 1999?

TIMSS and TIMSS–R data for several population groups showed an increase in performance between 1995 and 1999 in mathematics and science.[18] U.S. eighth-grade black students showed an increase in their mathematics achievement over the 4 years. Students whose parents were both U.S. born also showed an increase in mathematics achievement between 1995 and 1999. Students whose mothers or fathers attended some college or completed college also showed an increase in their mathematics performance over the 4 years. Finally, U.S. eighth-grade students whose mothers or fathers completed college showed an increase in science achievement over the 4 years (figure 22). There was no change found for the other groups of students shown in figure 22 over the 4 years in mathematics or science.

Figure 22.—Changes in U.S. eighth-grade mathematics and science achievement, by U.S. selected characteristics: 1995 and 1999

Mathematics			
	1995 average	1999 average	1995–1999 difference*
Sex			
Boys	495	505	10 ○
Girls	490	498	8 ○
Race/ethnicity			
White students	516	525	9 ○
Black students	419	444	25 △
Hispanic students	443	457	14 ○
National origin of parents			
Both U.S. born	496	510	13 △
Both foreign born	474	477	2 ○
1 U.S. born, 1 foreign born	482	496	13 ○
Mother's education			
High school or less	479	484	6 ○
Some college	498	511	13 △
Completed college	511	539	27 △
Father's education			
High school or less	474	482	8 ○
Some college	498	512	14 △
Completed college	515	543	28 △

Science			
	1995 average	1999 average	1995–1999 difference*
Sex			
Boys	520	524	5 ○
Girls	505	505	0 ○
Race/ethnicity			
White students	544	547	3 ○
Black students	422	438	16 ○
Hispanic students	446	462	16 ○
National origin of parents			
Both U.S. born	521	527	6 ○
Both foreign born	465	472	6 ○
1 U.S. born, 1 foreign born	498	509	11 ○
Mother's education			
High school or less	497	499	2 ○
Some college	522	525	3 ○
Completed college	531	554	23 △
Father's education			
High school or less	494	495	1 ○
Some college	521	529	8 ○
Completed college	534	560	25 △

△ The 1999 average is significantly higher than the 1995 average
○ The 1999 average is not significantly different from the 1995 average
▽ The 1999 average is significantly below the 1995 average

*Difference is calculated by subtracting the 1995 average from the 1999 average. Detail may not sum to totals due to rounding.

NOTE: Other factors are not controlled for in these analyses.

SOURCE: U.S. Department of Education, National Center for Education Statistics, Third International Mathematics and Science Study–Repeat (TIMSS–R), unpublished tabulations, 1999.

[18]The U.S. sample for TIMSS did not include sufficient numbers of nonpublic school students to reliably calculate achievement scores for this group.

The Mathematics and Science Achievement of the 1995 Fourth-Grade Cohort in 1999

TIMSS and other studies before it have suggested that the international performance of the United States relative to other nations appears lower at grade 8 in both mathematics and science than at grade 4. TIMSS–R provides data about the cohort of fourth-grade students in 1995 in comparison to the cohort of eighth-grade students four years later in 1999. However, direct comparisons between the 1995 fourth-grade assessment and the 1999 eighth-grade assessment are complicated by several factors: First, the fourth-grade and eighth-grade assessments include different test questions. By necessity, the kind of mathematics and science items that can be asked of an eighth-grader may be inappropriate for a fourth-grader. Second, because mathematics and science differ between the two grades, the content areas assessed also differ. That is, geometry and physics at grade 4 are different from geometry and physics at grade 8, for example. Without a sufficient set of in-common test items between the grade 4 and grade 8 assessments, it can be difficult to construct a reliable and meaningful scale on which to compare the 1995 fourth-graders to 1999 eighth-graders. Thus, for purposes of this report, comparisons between fourth and eighth grade are based on the performance relative to the international average of the 17 nations that participated in fourth-grade TIMSS and eighth-grade TIMSS–R.

Has the relative performance of the United States changed between fourth and eighth grade over the 4 years?

Figures 23 and 24 display a comparison of the average scores of the 17 nations between fourth-grade TIMSS and eighth-grade TIMSS–R to the international averages at both grades for each subject. The numbers shown in the figures are differences from the international average for the 17 nations. Nations are sorted into three groups: above the international average; similar to the international average; and below the international average.

In mathematics, the U.S. fourth-grade score in 1995 was similar to the international average of the 17 nations in common between fourth-grade TIMSS and eighth-grade TIMSS–R. At the eighth grade in 1999, the U.S. average in mathematics was below the international average of the 17 nations. Thus, U.S. fourth-graders performed at the international average in 1995 and U.S. eighth-graders performed below the international average in 1999 in mathematics, suggesting that the relative performance of the cohort of 1995 U.S. fourth-graders in mathematics was lower relative to this group of nations 4 years later. The data also suggest that, in mathematics, the relative performance of the cohort of 1995 fourth-graders in Canada was higher relative to this group of nations in 1999; the relative performance of the cohort of 1995 fourth-graders in the Czech Republic, Italy, and the Netherlands was lower relative to this group of nations 4 years later; and the relative performance of the cohort of 1995 fourth-graders in the 12 other nations was unchanged relative to this group of nations 4 years later.

Figure 23.—Mathematics achievement for TIMSS–R 1999 nations that participated in 1995 at both the fourth and eighth grades relative to the average across these nations

1995 Fourth grade Difference from average across 17 nations[1]	
Singapore	73
Korea, Republic of	63
Japan	50
Hong Kong SAR	40
(Netherlands)	32
Czech Republic	23
(Slovenia)	8
(Hungary)	4
United States	0
(Australia)	0
(Italy)	-7
Canada	-12
(Latvia-LSS)[2]	-18
(England)	-33
Cyprus	-42
New Zealand	-48
Iran, Islamic Republic of	-130
International average of 17 nations	517

1999 Eighth grade Difference from average across 17 nations[1]	
Singapore	80
Korea, Republic of	63
Hong Kong SAR	58
Japan	55
Netherlands	16
Hungary	8
Canada	7
Slovenia	6
Australia	1
Czech Republic	-4
Latvia-LSS[2]	-19
United States	-22
England	-28
New Zealand	-33
Italy	-39
Cyprus	-48
Iran, Islamic Republic of	-102
International average of 17 nations	524

Average is significantly higher than the international average
Average does not differ significantly from the international average
Average is significantly lower than the international average

[1]Difference is calculated by subtracting the international average of the 17 nations from the national average of each nation.

[2]Designated LSS because only Latvian-speaking schools were tested.

NOTE: Fourth and eighth grade in most nations. See appendix 2 for details.
Parentheses indicate nations not meeting international sampling and/or other guidelines at fourth grade in 1995. See NCES (1997c) for details.
The international average is the average of the national averages of the 17 nations.

SOURCE: Mullis et al. (2000). *TIMSS 1999 International Mathematics Report: Findings from IEA's Repeat of the Third International Mathematics and Science Study at the Eighth Grade.* Exhibit 1.4. Chestnut Hill, MA: Boston College.

In science, the U.S. fourth-grade score in 1995 was above the international average of the 17 nations in common between fourth-grade TIMSS and eighth-grade TIMSS–R. At the eighth grade in 1999, the U.S. average in science was similar to the international average of the 17 nations. Thus, U.S. fourth-graders performed above the international average in 1995 and U.S. eighth-graders performed similar to the international average in 1999 in science. As in mathematics, this suggests that the relative performance of the cohort of U.S. fourth-graders in science was lower relative to this group of nations 4 years later. The data also suggest that, in science, the relative performance of the cohort of 1995 fourth-graders in Singapore and Hungary was higher relative to this group of nations in 1999; the relative performance of the cohort of 1995 fourth-graders in Italy and the New Zealand was lower relative to this group of nations 4 years later; and the relative performance of the cohort of 1995 fourth-graders in the 12 other nations was unchanged relative to this group of nations 4 years later.

The available evidence appears to confirm what had been suggested 4 years ago: that the relative performance of U.S. students in mathematics and science is lower at the eighth grade than at the fourth grade among this group of nations.

Figure 24.—Science achievement for TIMSS–R 1999 nations that participated in 1995 at both the fourth and eighth grades relative to the average across these nations

1995 Fourth grade	Difference from average across 17 nations[1]
Korea, Republic of	62
Japan	39
United States	28
(Australia)	28
Czech Republic	18
(Netherlands)	17
(England)	14
Canada	12
(Italy)	10
Singapore	10
(Slovenia)	8
Hong Kong SAR	-6
(Hungary)	-6
New Zealand	-9
(Latvia-LSS)[2]	-27
Cyprus	-64
Iran, Islamic Republic of	-134
International average of 17 nations	514

1999 Eighth grade	Difference from average across 17 nations[1]
Singapore	44
Hungary	28
Japan	25
Korea, Republic of	24
Netherlands	21
Australia	16
Czech Republic	15
England	14
Slovenia	9
Canada[3]	9
Hong Kong SAR	5
United States	-9
New Zealand	-15
Latvia-LSS[2]	-21
Italy	-26
Cyprus	-64
Iran, Islamic Republic of	-76
International average of 17 nations	524

Average is significantly higher than the international average
Average does not differ significantly from the international average
Average is significantly lower than the international average

[1]Difference is calculated by subtracting the international average of the 17 nations from the national average of each nation.

[2]Designated LSS because only Latvian-speaking schools were tested.

[3]The shading of Canada in eighth grade may appear incorrect; however, statistically, its placement in correct.

NOTE: Fourth and eighth grade in most nations. See appendix 2 for details.
Parentheses indicate nations not meeting international sampling and/or other guidelines at fourth grade in 1995. See NCES (1997c) for details.
The international average is the average of the national averages of the 17 nations.

SOURCE: Martin et al. (2000). *TIMSS 1999 International Science Report: Findings from IEA's Repeat of the Third International Mathematics and Science Study at the Eighth Grade.* Exhibit 1.4. Chestnut Hill, MA: Boston College.

CHAPTER 3

TEACHING AND CURRICULUM

KEY POINTS

It is too early in the process of data analysis to provide strong evidence to suggest factors that may be related to patterns of achievement on TIMSS–R. However, differences in teaching and curriculum between the United States and other TIMSS–R nations were noted.

U.S. eighth-grade students were less likely than their international peers to be taught mathematics by teachers who majored in mathematics, but as likely as others to be taught by teachers who majored in mathematics education.

U.S. eighth-grade students were as likely as their international peers to be taught science by teachers with a college major or main area of study in biology, chemistry, or science education but less likely to be taught science by teachers with a degree in physics.

A greater percentage of U.S. eighth-graders than of their international peers reported using computers frequently in mathematics and science classes.

U.S. eighth-grade students spent less time than their international peers studying mathematics or science outside of school and doing mathematics or science homework outside of school.

Researchers, practitioners, and policymakers have paid a great deal of attention to the preparation, ongoing professional development, instructional practices, and curricular focus of teachers. Much of this attention has focused on developing programs, teaching methods, and curriculum materials to improve the achievement of all students. TIMSS–R collected data from students, teachers, and schools about systems, programs, curricular emphases, instructional practices, and other factors that have been put into place to support improved student learning.

The relationships between achievement and education-related background factors are complex. In this initial report, it was not possible to explore the potential relationships between achievement and the context of teaching, learning, and curriculum in the United States and the other participating nations with the care and thought needed to be confident in our interpretations. Therefore, although this report presents findings on the context of teaching, learning, and curriculum in the United States and the 37 other nations that participated in TIMSS–R in 1999, it does not relate any changes or differences in achievement to these background factors. Examination of these factors is included to stimulate discussion of the many varied approaches taken by nations. More in-depth analyses of the data that take into account the complex systems that support student learning, as well as findings from the data-rich TIMSS Video Study and the forthcoming TIMSS–R Videotape Classroom Study, will provide a better basis for understanding these interconnections and will lead to important findings.

This chapter is organized into three sections, in the following order:

- findings on the preparation and qualifications of mathematics and science teachers, as well as their ongoing professional development activities;
- findings on the intended and implemented mathematics and science curricula; and
- findings on classroom practices and activities.

The analyses that follow are limited to data collected in 1999 for the 38 TIMSS–R nations. For some analyses in science, comparisons are limited to the nations that generally organized science instruction as a single, general/integrated subject or as separate subjects in 1999. Unless otherwise indicated, the 38 TIMSS–R nations are compared in the science analyses in this chapter. A list of the nations that generally organized science instruction as a general/integrated subject or as separate subjects at the eighth grade are provided in table A4.1 in appendix 4.

Teacher Preparation, Qualifications, and Professional Development

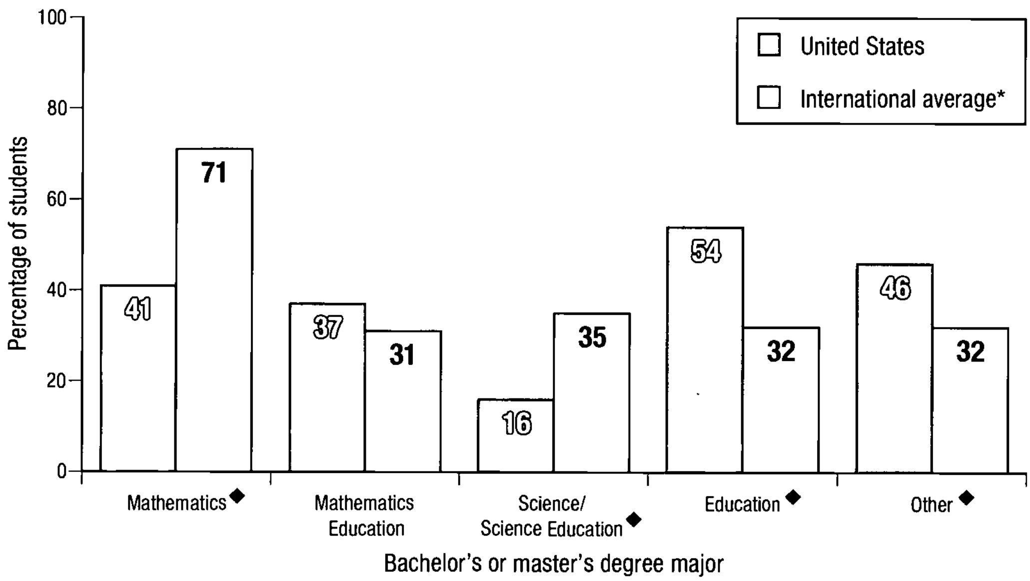
TIMSS–R collected information on the academic preparation, qualifications, and ongoing professional development of the mathematics and science teachers of eighth-grade students. Teachers' educational backgrounds and confidence in their abilities to teach mathematics and science were some of the factors considered as indicators of the extent to which teachers are prepared to teach. Data collected in TIMSS–R do not, however, provide a complete picture of teacher preparedness.

What educational backgrounds did our mathematics teachers have in 1999?

Over the last several years, some have argued that it is important for teachers to have subject matter expertise, and one indication of this is a major in subjects they teach, either at the bachelor's or master's level. TIMSS–R asked the mathematics and science teachers of eighth-grade students about their majors at the bachelor's and master's level. Teachers could indicate that they had more than one major or main area of study if applicable. U.S. eighth-grade students were less likely than their international peers to be taught by a mathematics teacher with a bachelor's or master's degree majoring in mathematics. In 1999, 41 percent of U.S. eighth-grade students had a mathematics teacher whose bachelor's degree or master's major or main area of study was in mathematics, a smaller percentage than the international average of 71 percent of students (figure 25). Compared to the United States, a higher percentage of students in 29 of the 37 other nations were taught by a mathematics teacher with a bachelor's or master's or equivalent major in mathematics. Canada and Italy were the only nations that reported lower percentages than the United States.

U.S. eighth-grade students were as likely as their international peers to be taught by a mathematics teacher with a bachelor's or master's degree major in mathematics education. Thirty-seven percent of U.S. eighth-grade students were taught mathematics by a teacher whose bachelor's or master's major was in mathematics education. This is comparable to the international average of 31 percent of students.

Figure 25.—Eighth-grade mathematics teachers' reports on their main area of study: 1999



*The item response rate for this question was less than 70 percent in some nations. See Mullis et al. (2000) for details.
◆Significant difference between U.S. average and international average in this category.

NOTE: Science includes biology, physics, chemistry, and science education.
Based on mathematics teachers' reports of main area or areas of study for bachelor's and/or master's degree; more than one category could be selected.
Eighth grade in most nations. See appendix 2 for details.
The international average is the average of the national averages of the nations that reported data.

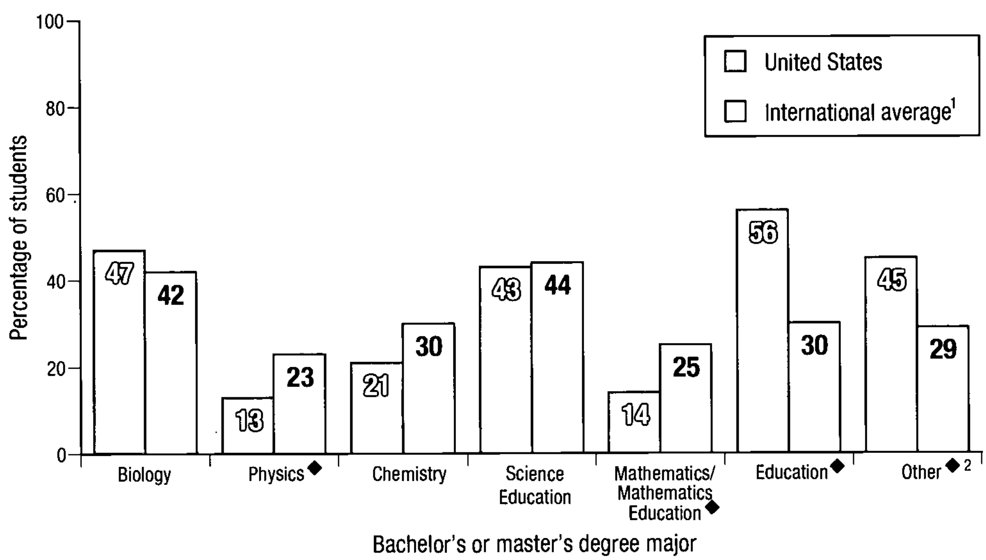
SOURCE: Mullis et al. (2000). *TIMSS 1999 International Mathematics Report: Findings from IEA's Repeat of the Third International Mathematics and Science Study at the Eighth Grade.* Exhibit R3.1. Chestnut Hill, MA: Boston College.

What educational backgrounds did our science teachers have in 1999?

For this analysis, science teachers of U.S. students were compared to science teachers in other nations that generally taught science as a general/integrated science curriculum.[1] In addition to the United States, 22 other nations indicated they generally teach their eighth-grade students with this type of a science curriculum (see table A4.1). Unlike mathematics teachers, science teachers often obtained degrees in the different content areas of science such as biology, physics, and chemistry. Therefore, it is important to compare the percentage of students whose teachers held a bachelor's or master's degree in one of these specific areas. Teachers could indicate that they had more than one major or main area of study, if applicable.

In 1999, 47 percent of U.S. eighth-grade students were taught by science teachers with a college major or main area of study in biology, 13 percent of our students were taught by science teachers with a college major or main area of study in physics, and 21 percent of our students were taught by science teachers with a college major or main area of study in chemistry (figure 26). The percentage of U.S. students taught by science teachers with a college major or main area of study in biology or chemistry was similar to the international averages for these categories, while the percentage of U.S. students taught science by teachers with a college major or main area of study in physics was lower than the international average.

Figure 26.—Eighth-grade science teachers' reports on their main area of study: 1999



◆Significant difference between U.S. average and international average in this category.
[1]The item response rate for this question was less than 70 percent in some nations. See Martin et al. (2000) for details.
[2]Other may include areas of study in earth science fields.

NOTE: Based on science teachers' reports of main area or areas of study for bachelor's and/or master's degree; more than one category could be selected.
Eighth grade in most nations. See appendix 2 for details.
The international average is the average of the national averages of the nations that reported teaching a general/integrated science curriculum.

SOURCE: Martin et al. (2000). *TIMSS 1999 International Science Report: Findings from IEA's Repeat of the Third International Mathematics and Science Study at the Eighth Grade.* Exhibit R3.1. Chestnut Hill, MA: Boston College.

[1]The National Research Coordinator of each nation was asked to complete a questionnaire that, among other things, asked if science was taught as a general/integrated subject or as separate subjects such as Earth Science, Biology, Physics, and Chemistry. The Council of Chief State School Officers (CCSSO) supplied information for the United States. The United States is one of 23 nations in TIMSS–R that, in general, teaches science as a general/integrated subject at the eighth-grade level. The questionnaire did not distinguish between general science and integrated science. See table A4.1 in appendix 4.

In addition to, or in lieu of, content area–specific degrees, teachers can also major in science education. In 1999, 43 percent of U.S. eighth-grade science students were taught by science teachers with a bachelor's or master's degree major in science education. This was similar to the international average of 44 percent.

How confident were mathematics teachers in their preparation to teach mathematics subjects?

In addition to asking about the educational background of teachers, TIMSS–R asked teachers how confident they were to teach mathematics as a gauge of their own sense of preparedness.

In general, more U.S. teachers of eighth-grade students reported feeling very well prepared to teach mathematics compared to their counterparts in other nations in 1999. In mathematics, the United States was among the top group of nations in which a large percentage of its students were taught by teachers who reported feeling "very well prepared" to teach mathematics (figure 27). On average, 90 percent of U.S. eighth-graders had teachers who felt "very well prepared" to teach across the topics covered by the TIMSS–R mathematics framework. In this respect, the United States was similar to 9 nations and was higher than 25 nations as well as the international average.

Ninety percent or more of U.S. eighth-grade students were taught by teachers who reported they were "very well prepared" to teach 7 of the 12 topics asked about.[2] For the other 5 topics (*measurement–units, instruments, and accuracy; geometric figures–definitions and properties; geometric figures–symmetry; simple probabilities–understanding and calculations;* and *coordinate geometry*), 75 to 86 percent of U.S. eighth-graders were taught by mathematics teachers who felt "very well prepared" to teach these topics. For 11 of the 12 mathematics topics covered in TIMSS–R, the percentage of U.S. students taught by teachers who felt "very well prepared" exceeded the international average.

Interpretation of these data should take into account cultural and curricular issues, however. For example, teachers in some cultures may be more reserved about discussing their strengths and abilities. Teachers' reports on their confidence levels to teach a subject area may be influenced by cultural norms and expectations. Moreover, teachers' reports on their confidence levels may also reflect the emphases of the curricula they are expected to teach. For example, if the mathematics standards or curriculum emphasizes a particular set of topics and does not emphasize another set of topics, teachers may feel less prepared to teach those topics that they are not usually expected to present. Curricular issues are dealt with to a certain degree in TIMSS–R, and the areas emphasized in each nation's curriculum as well as the topics covered by teachers are discussed later in this chapter.[3] Cultural issues are outside the scope of TIMSS–R but can be found throughout the research literature.

[2]The 7 mathematics topics where 90 percent or more of U.S. eighth-grade students were taught by teachers who report they were "very well prepared" are *fractions, decimals, and percentages; ratios and proportions; perimeter, area, and volume; algebraic representation; evaluate and perform operations on algebraic expressions; solving linear equations and inequalities; representation and interpretation of data in graphs, charts, and tables.*

[3]TIMSS–R collected information from the mathematics and science teachers of the eighth-graders about the curricular topics covered and emphasized most in the classroom. TIMSS–R did not include an in-depth curriculum analysis, as in TIMSS.

Figure 27.—Teachers' beliefs about their preparation to teach mathematics and science: 1999

Percentage of eighth-grade students whose mathematics teachers reported feeling very well prepared to teach mathematics

Nation	Percent
Macedonia, Republic of	92
United States	90
Cyprus	89
Slovak Republic	89
Jordan	88
Czech Republic	88
New Zealand	88
Romania	85
Australia	84
(Israel)[1]	84
Netherlands	84
Turkey	83
Finland	81
Iran, Islamic Republic of	81
Malaysia	81
Indonesia	81
Belgium-Flemish	80
Canada	79
Singapore	78
Chinese Taipei	78
Morocco	75
Latvia-LSS[2]	73
Hong Kong SAR	72
South Africa	71
Italy	69
Bulgaria	66
Moldova	64
Philippines	64
Korea, Republic of	61
Hungary	59
Tunisia	51
Slovenia	50
Chile	44
Thailand	32
Japan	23
England	—
Lithuania	—
Russian Federation	—

International average of 35 nations	73

Percentage of eighth-grade students whose science teachers reported feeling very well prepared to teach science

Nation	Percent
Macedonia, Republic of	72
Czech Republic	64
Turkey	63
New Zealand	59
United States	58
Indonesia	58
Romania	57
Morocco	57
Cyprus	57
Jordan	57
Australia	55
(Israel)	55
South Africa	53
Netherlands	50
Finland	47
Belgium-Flemish	47
Bulgaria	46
Singapore	46
Canada	44
Italy	42
Chinese Taipei	42
Iran, Islamic Republic of	42
Philippines	41
Moldova	39
Latvia-LSS[2]	37
Hong Kong SAR	34
Tunisia	32
Korea, Republic of	31
Thailand	30
Hungary	29
Chile	29
Malaysia	22
Japan	17
England	—
Lithuania	—
Russian Federation	—
Slovak Republic	—
Slovenia	—

International average of 33 nations	46

Average is significantly higher than the U.S. average
Average does not differ significantly from the U.S. average
Average is significantly lower than the U.S. average

— Data not available.

[1]The shading of Israel may appear incorrect; however, statistically its placement is correct.

[2]Designated LSS because only Latvian-speaking schools were tested which represents 61 percent of the population.

NOTE: Eighth grade in most nations. See appendix 2 for details.
Parentheses indicate nations not meeting international sampling and/or other guidelines. See appendix 2 for details.
The international average is the average of the national averages of the nations that provided data.

SOURCE: Martin et al. (2000). *TIMSS 1999 International Science Report: Findings from IEA's Repeat of the Third International Mathematics and Science Study at the Eighth Grade.* Exhibit R3.2. Chestnut Hill, MA: Boston College; Mullis et al. (2000). *TIMSS 1999 International Mathematics Report: Findings from IEA's Repeat of the Third International Mathematics and Science Study at the Eighth Grade.* Exhibit R3.2. Chestnut Hill, MA: Boston College.

How confident were science teachers in their preparation to teach science subjects?

Overall, the picture of teacher confidence in presenting science topics appears different from the one described for mathematics. Fifty-eight percent of U.S. eighth-graders had science teachers who felt "very well prepared" to teach across the science topics covered in the TIMSS–R framework (figure 27). In comparison to the 37 other TIMSS–R nations, the United States was similar to 11 nations and was higher than 20 nations as well as the international average. It appears that science teachers reported feeling less confident about their preparedness to teach eighth-grade science topics than their mathematics counterparts when considering the international average percentage of students taught by a teacher who felt "very well prepared" to teach mathematics (73 percent) or science (46 percent), internationally.

Forty to sixty-five percent of U.S. eighth-grade students had science teachers who felt "very well prepared" to teach 9 of the 10 topics asked about. In only one topic area, *scientific methods and inquiry skills*, did science teachers of more than 80 percent of eighth-grade students in the United States feel "very well prepared" to teach.

Compared to the international average, the United States had a higher percentage of its students taught by science teachers who felt "very well prepared" to teach in 4 of the 10 science topic areas: *earth science–features; earth science–solar system; environmental and resource issues*; and *scientific methods and inquiry skills.* In the other 6 topic areas,[4] the United States was similar to the international average.

Again, interpretation of these data should take into account possible cultural and curricular issues that can affect teachers' reports of their confidence to teach subject-specific topics.

In what types of professional development activities did our mathematics teachers participate?

The United States asked mathematics and science teachers of TIMSS–R students to describe their professional development experiences during the 1998–99 school year, defined as June 1998 to May 1999. Only U.S. teachers were asked about their participation in 11 types of professional development activities[5]; thus, cross-national comparisons cannot be made.

Of the 11 types of professional development asked about in the U.S. teacher questionnaires, within-district workshops or institutes and courses for college credit were generally the most frequent types of activities that mathematics teachers of U.S. eighth-grade students participated in during the 1998–99 school year. On average, U.S. eighth-grade students were taught mathematics by teachers who attended 12 clock hours of within-district workshops or institutes and 9 clock hours of courses for college credit[6] over the course of a year. These professional development activities may or may not have been specifically mathematics-focused.

In what types of professional development activities did our science teachers participate?

The story appears similar for the science teachers of U.S. students. Of the 11 types of professional development activities asked about in the teacher questionnaires, within-district workshops or institutes and courses for college credit were generally the most frequent types of activities that science teachers of U.S. eighth-grade students participated in during the 1998–99 school year. On average,

[4]The 6 science topics where the United States had a similar percentage of students with teachers feeling "very well prepared" compared to the international average are *biology–human systems; biology–plant and animal life; chemistry–matter; chemistry–chemical reactivity; physics–types of energy;* and *physics–light*.

[5]U.S. mathematics and science teachers were asked about their participation in the following 11 types of professional development activities: within-district workshops or institutes; courses for college credit; out-of-district workshops and institutes; teacher collaboratives or networks; out-of-district conferences; immersion or internship activities; receiving mentoring, coaching, lead teaching, or observation; teacher resource centers; committees or task forces; teacher study groups; and other forms of organized professional development. These questions were not asked in any other nation in TIMSS–R.

[6]This average includes teachers who did not take any courses for college credit; therefore, the average hours spent in such courses by those teachers who took them may be underreported.

U.S. eighth-grade students were taught by a science teacher who attended around 12 clock hours of within-district workshops or institutes and 12 clock hours of courses for college credit. In addition, science teachers of U.S. eighth-grade students spent almost 7 clock hours in committees or task forces over the course of a year.

Did our mathematics teachers observe one another teaching?

Some research suggests that the experience of teachers observing other teachers can contribute to the sharing of good practices. TIMSS–R asked the mathematics and science teachers of U.S. eighth-grade students about the number of class periods they observed other teachers in the last year and the number of periods other teachers observed them in the past year. It is important to note that the questionnaire did not ask teachers about the purpose of their participation in observation activities. Again, this question was asked only of U.S. mathematics and science teachers.

In general, the mathematics teachers of U.S. eighth-grade students rarely participated in observational activities. On average, U.S. eighth-grade students were taught by mathematics teachers who spent 1 class period during the 1998–99 school year observing other teachers and who were observed by other teachers during 2 class periods. There were no differences in the average number of class periods mathematics teachers observed other teachers or were observed by other teachers based on years of teaching experience.

Did our science teachers observe one another teaching?

The science teachers of U.S. eighth-grade students also rarely participated in observational activities. On average, U.S. eighth-graders were taught by science teachers who observed other teachers for 1 class period during the 1998–99 school year and who were observed by other teachers for 1 class period. However, the situation was different for U.S. eighth-grade students whose science teachers had the fewest years of experience (0–5 years): their teachers spent approximately 3 periods observing other teachers, a greater number of periods than science teachers with more years of experience.

What topics were emphasized in professional development activities for U.S. mathematics teachers?

In addition to exploring the types of professional development activities in which teachers of U.S. eighth-grade students participated, the U.S. mathematics and science teacher questionnaires asked about the topics emphasized during professional development activities.

Overall, mathematics teachers of U.S. eighth-grade students reported their professional development activities emphasized curriculum more than any other topic. Mathematics teachers who stated their professional development activities emphasized curriculum either "quite a lot" or "a great deal" taught 64 percent of U.S. eighth-grade students (figure 28). This was a higher percentage than the percentage for any other topic asked about.

Figure 28.—Percentage of U.S. eighth-grade students taught by teachers that participated in professional development activities that emphasized different topics: 1999

Professional development topic	Percentage of U.S. 8th-grade students taught by teachers who said their professional development activities emphasized the topic "quite a lot" or "a great deal"	
	Mathematics	Science
Curriculum	64	59
Subject-specific teaching methods in mathematics or science	40	40
General teaching methods	38	44
Approaches to assessment	33	37
Use of technology in instruction	44	46
Strategies for teaching diverse student populations	21	23
Information on how students learn mathematics or science	21	23
Deepening teacher's knowledge of mathematics or science	28	50
Leadership development	16	19

SOURCE: U.S. Department of Education, National Center for Education Statistics, Third International Mathematics and Science Study–Repeat (TIMSS-R), unpublished tabulations, 1999.

What topics were emphasized in professional development activities for U.S. science teachers?

Professional development activities related to curriculum also appear to be most frequent among science teachers of U.S. eighth-grade students, followed closely by activities related to general teaching methods, use of technology in instruction, and deepening teachers' knowledge of science. Fifty-nine percent of eighth-grade students were taught by science teachers reporting their professional development activities emphasized curriculum either "quite a lot" or "a great deal" (figure 28). This percentage was similar to the percentage of eighth-grade students taught by science teachers reporting their professional development activities emphasized general teaching methods, using technology, and deepening teacher's knowledge of science.

CURRICULUM, CONTENT COVERAGE, AND EMPHASES

Data on teacher preparation and professional development provide information on the readiness of teachers to instruct students. Combining these data with information on what teachers present and how they present it gives us a more complete picture of teaching and learning experiences in classrooms around the world. The following sections discuss the structure and scope of U.S. mathematics and science curricula in comparison to other TIMSS–R nations, as well as the instructional practices of mathematics and science teachers in the participating nations.

Who sets the curriculum in TIMSS–R nations?

Most of the 38 TIMSS–R nations have implemented a national mathematics and science curriculum. Australia, Canada, and the United States are the three TIMSS–R nations with regionally or locally determined curricula. Curriculum is determined at the state or provincial level in Australia and Canada. Curriculum is determined at the local level in the United States. Throughout this report, we treat Australia, Canada, and the United States as if they each had a national curriculum, for comparative purposes. However, it is important to remember that these three nations do not have national curricula in mathematics and science.

How much of each TIMSS–R content area did the intended U.S. curriculum cover?

In an effort to better understand the mathematics and science achievement of eighth-grade students, TIMSS–R collected information on each nation's mathematics and science curricula as it was intended to be taught to students.[7] This information can put achievement results in perspective by revealing those content areas that most eighth-grade students have been exposed to in their educational experiences up to and including eighth grade, and those that they have not yet been exposed to.[8] For example, if the intended mathematics or science curriculum in a nation does not emphasize the topics in a particular content area, or only a select group of students is intended to learn a particular topic, then we would be less likely to expect that nation's students to perform well in that content area on TIMSS–R.

Across the five content areas in mathematics and the six content areas in science examined in TIMSS–R, the intended U.S. mathematics and science curricula appear to have had a higher percentage of overall coverage of the TIMSS–R content areas than the international average. In mathematics, 93 percent of the topics included in the content areas overall were intended to be taught to all or almost all (at least 90 percent) of U.S. students in 1999. The international average of intended coverage to all or almost all students was 75 percent of the topics in the five mathematics content areas. One hundred percent of the topics in three mathematics content areas—*fractions and number sense*; *measurement*; and *data representation, analysis, and probability*—were intended to be taught to all or almost all U.S. eighth-grade students. Eighty-five percent of the topics in *geometry* and 82 percent of the topics in *algebra* were intended to be covered.

Similarly, 86 percent of the topics in the six science content areas overall were intended to be taught to all or almost all (at least 90 percent) of U.S. students in 1999. The international average across the TIMSS–R nations was 62 percent. One hundred percent of the topics in five of the six science content areas—*earth science*; *biology*; *physics*; *environmental and resource issues*; and *scientific inquiry and the nature of science*—were intended to be taught to all or almost all U.S. eighth-grade students. Fifty percent of topics in *chemistry* were intended to be covered.

[7] Findings are based on information provided by each nation's National Research Coordinator (NRC). In the United States, this information was provided by the Council of Chief State School Officers.

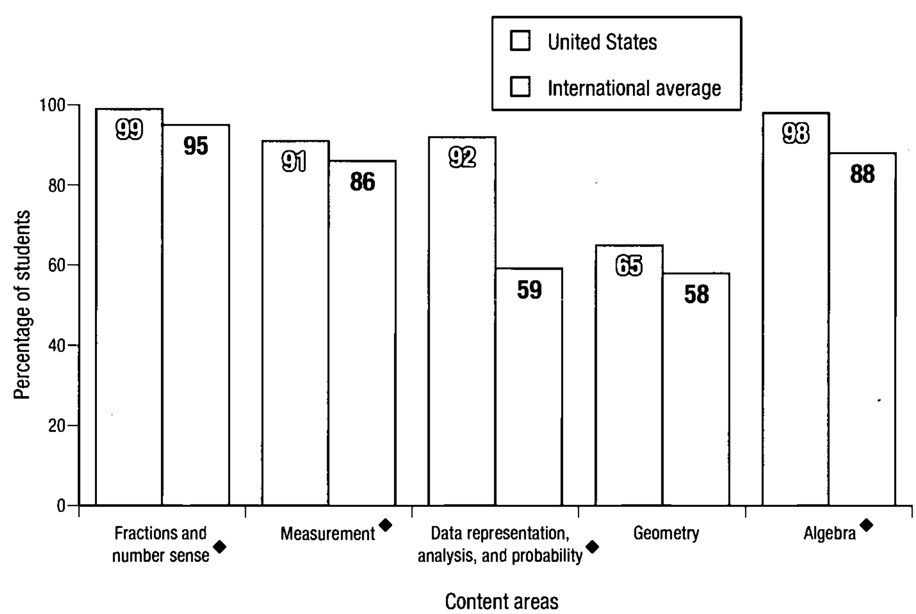
[8] Schmidt, McKnight, et al. (1997) and Schmidt, Raizen, et al. (1997) conducted in-depth analyses of the mathematics and science topics covered in the textbooks and curriculum guides used in nations as well as the depth of the topics presented. TIMSS–R did not collect information on the depth of coverage of topics by mathematics and science teachers. Comparisons between the findings of Schmidt et al. and TIMSS–R cannot be made here.

How much of the mathematics curriculum was taught?

TIMSS–R asked mathematics and science teachers of eighth-grade students about the curriculum that is actually taught in the classroom. Like information about the intended curriculum, information about what is actually taught can put achievement scores into perspective by revealing what content areas have and have not been covered by the time students near completion of the eighth grade.

The percentage of eighth-graders whose teachers reported they had taught each content area in mathematics and science varied across the TIMSS–R nations. "Taught" is defined as the sum of percentages of students whose teachers reported these areas as either taught before this year or taught more than five periods this year. Four of the five mathematics content areas—*fractions and number sense*; *measurement*; *data representation, analysis, and probability*; and *algebra*—were taught to between 91 percent and 99 percent of U.S. eighth-grade students, which was higher than the international average of the TIMSS-R nations for each of these content areas. On the other hand, 65 percent of U.S. eighth-grade students were taught *geometry* according to their mathematics teachers, a percentage similar to the international average (figure 29).

Figure 29.—Percentage of U.S. eighth-grade students "taught" mathematics content areas: 1999



◆Significant difference between U.S. average and international average in this category.

NOTE: "Taught" equals the sum of percentages of students whose mathematics teachers reported these content areas as either "taught before this year" or "taught more than five periods this year."
Eighth grade in most nations. See appendix 2 for details.
The international average is the average of the national averages of the nations that reported data.

SOURCE: U.S. Department of Education, National Center for Education Statistics, Third International Mathematics and Science Study-Repeat (TIMSS-R), unpublished tabulations, 1999.

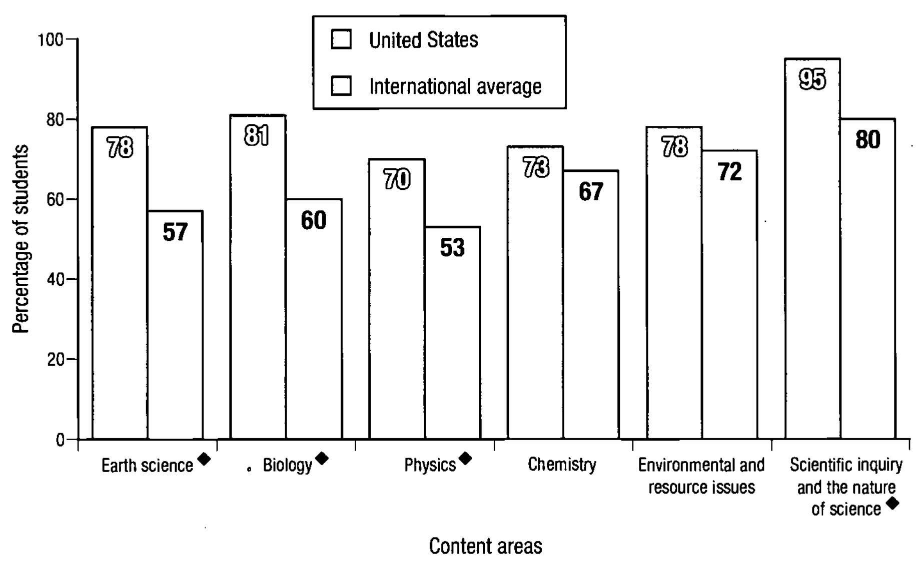
How much of the science curriculum was taught?

The percentage of U.S. eighth-grade students taught the six science content areas in TIMSS–R varied as well. Science teachers of 95 percent of U.S. eighth-graders reported that *scientific inquiry and the nature of science* was taught before the TIMSS–R assessment (figure 30). Science teachers of between 70 and 81 percent of U.S. eighth-graders reported that the other five content areas—*earth science*; *biology*; *physics*; *chemistry*; and *environmental and resource issues*—were taught before the assessment was given. Four of the six content areas—*earth science*; *biology*; *physics*; and *scientific inquiry and the nature of science*—were taught to a higher percentage of U.S. eighth-graders than the international averages for each of these four areas.

Which topics were emphasized most in U.S. eighth-grade curricula?

In 1999, a higher percentage of U.S. eighth-grade students had mathematics teachers who reported emphasizing *general mathematics* (28 percent) or *algebra* (27 percent) than the international averages of the 38 nations for each of these topics. U.S. eighth-grade students were less likely to be in classes where the emphasis was a combination of *algebra and geometry* or *algebra, geometry, numbers, and other topics* than the international average. No nation had a greater percentage of students taught by mathematics teachers who emphasized *algebra* as a single topic than the United States. That is, U.S. eighth-grade students were more likely to be in a mathematics class that emphasized *algebra* as a discrete topic than their international peers, who were more likely to be in mathematics classes that combine *algebra* with other topics such as *geometry*. Evidence from the TIMSS study showed that what is interpreted as *algebra* can vary among mathematics teachers from different nations (Stigler et al. 1999).

Figure 30.—Percentage of U.S. eighth-grade students "taught" science content areas: 1999



◆Significant difference between U.S. average and international average in this category.

NOTE: "Taught" equals the sum of percentages of students whose science teachers reported these topics as either "taught before this year" or "taught more than five periods this year."
Eighth grade in most nations. See appendix 2 for details.
The international average is the average of the national averages of the nations that reported data.

SOURCE: U.S. Department of Education, National Center for Education Statistics, Third International Mathematics and Science Study-Repeat (TIMSS-R), unpublished tabulations, 1999.

The majority of U.S. eighth-grade students were in a science class where the teacher emphasized one of three subjects the most: *general/integrated science*, *earth science*, or *physical science*. Forty-one percent of U.S. eighth-grade students were in a class where *general/integrated science* was emphasized, which is lower than the international average (58 percent) of the nations that generally teach *general/integrated science*. The 28 percent of U.S. students whose teachers emphasized *earth science* was above the international average of 5 percent, and the 21 percent of U.S. eighth-grade students whose teachers emphasized *physical science* was also higher than the international average of 11 percent. Fewer U.S. eighth-grade students had teachers who emphasized *biology* (5 percent) or *physics* (2 percent) than the international averages (14 percent and 6 percent, respectively).

Did the TIMSS–R nations' curricula accommodate students with varying degrees of interests and abilities?

The United States was one of 30 TIMSS–R nations that addressed the issue of students having varying levels of interests and abilities in their mathematics curricula, and one of 27 nations that addressed differentiation in their science curricula.[9] The two most common approaches to addressing differentiation in mathematics and science classes were teaching the same curriculum to all students, with teachers adapting to different student needs, or "streaming" students by grade or ability level. These approaches have also been taken in the United States.

When schools were asked how their mathematics classes accommodated students with different abilities or interests in mathematics and science, schools of 79 percent of U.S. eighth-grade students responded that enrichment mathematics was offered, which was above the international average of 58 percent.[10] In science, schools of 34 percent of U.S. eighth-grade students said they offered enrichment science classes, a lower percentage than the international average of 50 percent. In addition, 64 percent of U.S. eighth-grade students were in schools that offered remedial mathematics, similar to the international average of 72 percent. Seventeen percent of U.S. eighth-grade students were in schools offering remedial science, a lower percentage than the international average of 53 percent.

Classroom Practices and Activities

TIMSS–R asked eighth-grade students and their mathematics and science teachers about various practices and activities that took place in the classroom, including use of calculators in mathematics lessons and use of computers and the Internet in science and mathematics lessons. The kinds of skills that students are asked to practice and the types of activities that they participate in during lessons can promote and reinforce learning, particularly when combined with a coherent and well-planned curriculum. Students' and teachers' reports of some of the practices and activities in the classroom are presented below.

What kinds of skills did U.S. mathematics and science teachers report asking their students to use during lessons?

Mathematics teachers of eighth-grade students were surveyed on whether they asked their students to perform each of the following in "most or every lesson": explain the reasoning behind an idea; represent and analyze relationships using tables, charts, or graphs; work on problems with no solution; write equations to represent relationships; and practice computational skills. A greater percentage of U.S. eighth-grade students were asked by their mathematics teachers to write equations to represent relationships in most or every lesson (54 percent) than the international average (43 percent). U.S. students were as likely to be asked by their mathematics teachers to practice each of the other skills as their international peers.

[9]Based on information provided by each nation's National Research Coordinator (NRC).

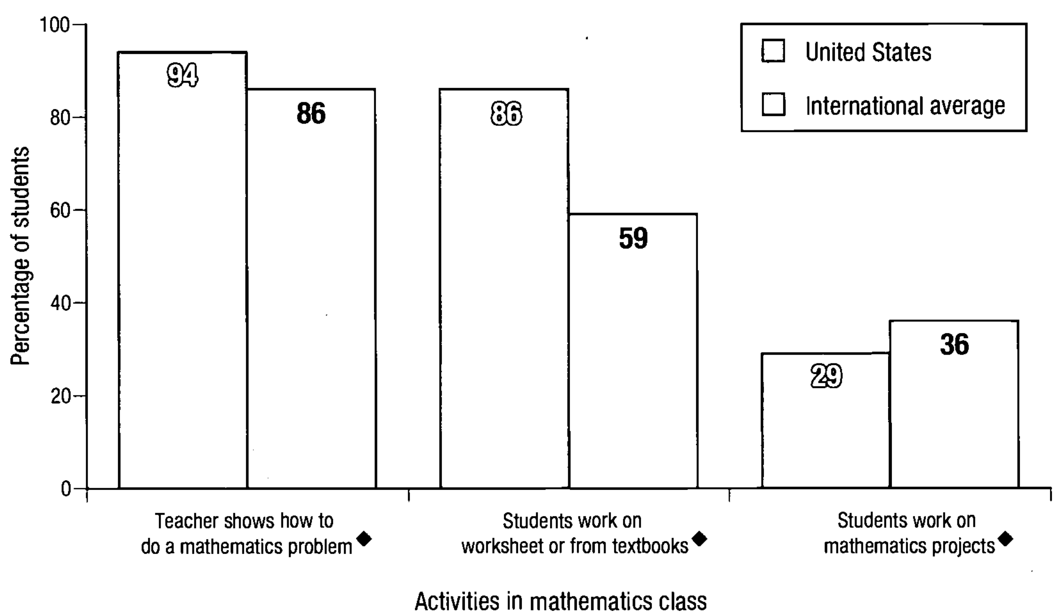
[10]School information provided by the principal or head administrator of the school.

A similar question was asked of science teachers in all 38 TIMSS–R nations. Science teachers reported on whether they asked their eighth-grade students in "most or every lesson" to explain the reasoning behind an idea; represent and analyze relationships using tables, charts, or graphs; work on problems with no solution; write explanations about what was observed and why it happened; or put events or objects in order. Eighty percent of U.S. eighth-grade students were asked by their science teachers to explain the reasoning behind an idea in most or every science lesson, a higher percentage than the international average of 67 percent of students. A majority of U.S. eighth-grade students (59 percent) were also asked by their science teachers to write explanations about what was observed and why it happened in most or every science lesson, which was similar to the international average of 52 percent. U.S. eighth-grade students were also as likely as their international peers to be asked to represent and analyze relationships, work on problems with no solution, and put events or objects in order in most or every science lesson.

What activities did U.S. students report occurring in their mathematics and science classes?

Students were asked to report on how often their mathematics teachers showed them how to do a mathematics problem, asked them to work from worksheets or textbooks on their own, asked them to work on mathematics projects, or asked them to use things from everyday life in solving mathematics problems. Ninety-four percent of U.S. eighth-grade students said that their teachers showed them how to do mathematics problems "almost always" or "pretty often" (figure 31). This was higher than the international average of 86 percent. Only one nation, Singapore, had a greater percentage of students report that their mathematics teachers showed them how to do a problem during the lesson almost always or pretty often than the United States. A greater percentage of U.S. eighth-grade students also reported that they worked from worksheets or textbooks on their

Figure 31.—Eighth-grade students' reports of the occurrence of selected activities in their mathematics class "almost always" or "pretty often": 1999



◆Significant difference between U.S. average and international average in this category.

NOTE: Eighth grade in most nations. See appendix 2 for details.
The international average is the average of the national averages of the nations that reported data.

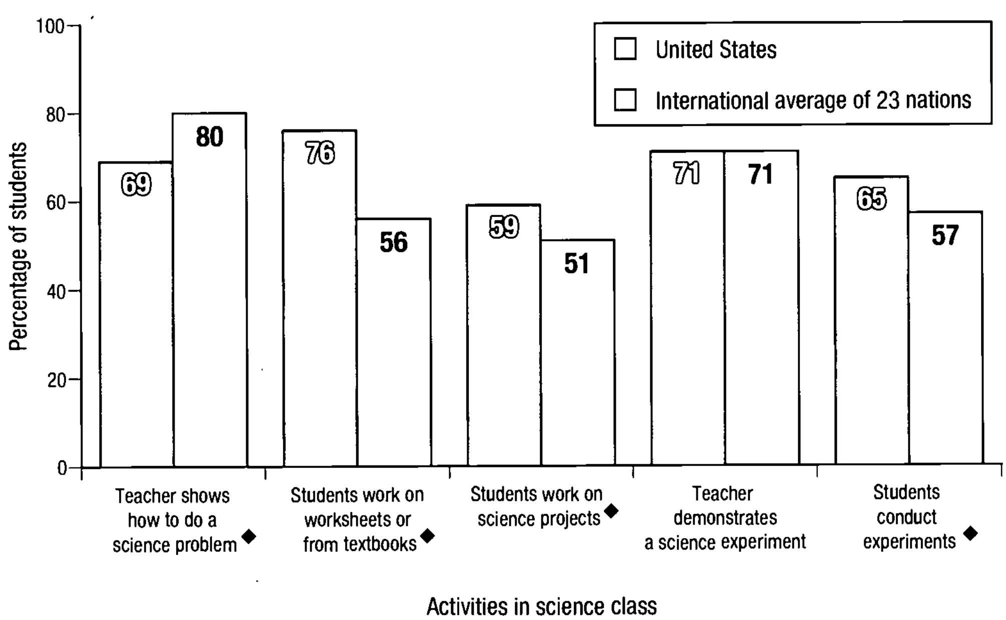
SOURCE: Mullis et al. (2000). *TIMSS 1999 International Mathematics Report: Findings from IEA's Repeat of the Third International Mathematics and Science Study at the Eighth Grade.* Exhibit 6.11. Chestnut Hill, MA: Boston College.

own almost always or pretty often during mathematics lessons (86 percent) than the international average (59 percent). On the other hand, a smaller percentage of U.S. students reported that they worked on mathematics projects during their mathematics lessons (29 percent) than the international average (36 percent). Finally, TIMSS–R data indicate that 23 percent of U.S. eighth-grade students reported that they almost always use things from everyday life in solving mathematics problems during their mathematics lessons. This was a greater percentage than the international average of 15 percent (not included in figure).

Students were also asked to report on how often their science teachers showed them how to do a problem, asked them to work from worksheets or textbooks on their own, asked them to work on science projects, demonstrated an experiment in class, or asked students to conduct an experiment in class. In science, 69 percent of U.S. eighth-graders reported being shown how to do science problems by their science teachers "almost always" or "pretty often" during their science lessons (figure 32). This was a lower percentage than the international average (80 percent) of the 23 nations that teach an integrated/general science curriculum. Seventy-six percent of U.S. eighth-grade students also reported that they were almost always or pretty often asked to work from worksheets or textbooks and 59 percent stated that they work on science projects during science lessons, greater percentages than the international averages of 56 percent and 51 percent, respectively.

When students were asked how often their science teachers gave demonstrations of experiments, 71 percent of U.S. eighth-grade students reported that this occurred almost always or pretty often during their science lessons in 1999. Internationally, among the 23 nations with general/integrated science in eighth grade, an equivalent percentage of their international peers reported that their science teachers gave demonstrations of experiments during science lessons. When students were asked how often they did an

Figure 32.—Eighth-grade students' reports of the occurrence of selected activities in their science class "almost always" or "pretty often": 1999



◆Significant difference between U.S. average and international average in this category.

NOTE: Eighth grade in most nations. See appendix 2 for details.
The international average is the average of the national averages of the 23 nations that reported teaching a general/integrated science curriculum in 1999.

SOURCE: Martin et al. (2000). *TIMSS 1999 International Science Report: Findings from IEA's Repeat of the Third International Mathematics and Science Study at the Eighth Grade.* Exhibits 6.10, R3.11, and R3.13. Chestnut Hill, MA: Boston College.

experiment or practical investigation in their science lesson, 65 percent of U.S. eighth-graders reported that this occurred almost always or pretty often during their science lessons. This represented a higher percentage of students than the international average of 57 percent.

How often did U.S. students use calculators in their mathematics lessons?

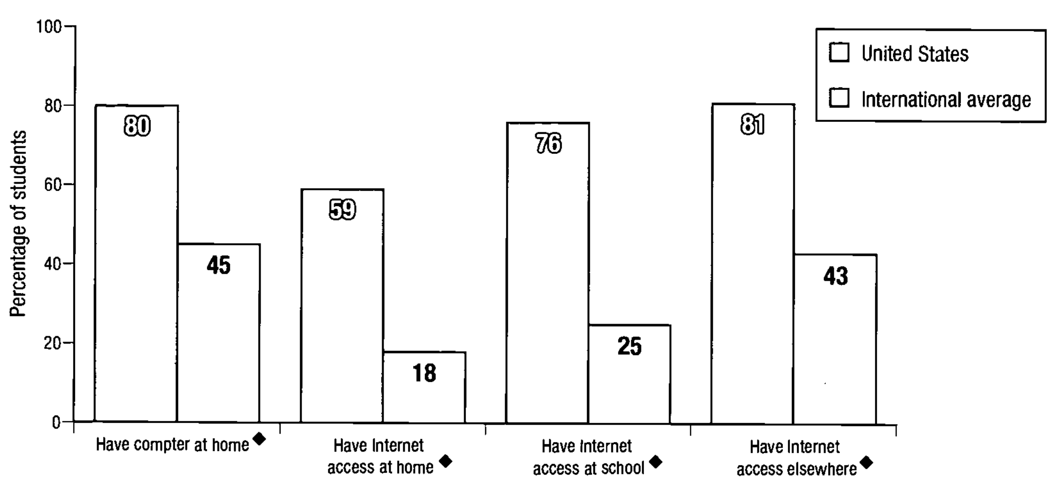
In 1999, 42 percent of U.S. eighth-grade students reported that they "almost always" used calculators in their mathematics lessons. This was a higher percentage of students than the international average (19 percent). In comparison to the United States, two nations—the Netherlands and Australia—had a higher percentage of students responding that they used calculators almost always in their mathematics lessons. Eight percent of U.S. eighth-grade students reported never using calculators in their mathematics lessons, which was lower than the international average of 32 percent of students.

Did students have access to computers and the Internet, and how did schools, teachers, and students report using these tools?

Some believe that access to computers, software, and the Internet provides additional tools for teachers to create meaningful lessons from which students can learn, helping to reinforce and supplement their classroom learning. In short, it is believed that these technological tools can, when coherently integrated into lessons, create additional opportunities for learning.

Access to computers and the Internet is the first step toward using these technological tools in teaching and learning mathematics and science. U.S. students had a high level of access to computers and the Internet at home and at school relative to eighth-graders in other nations in 1999. Eighty percent of U.S. eighth-graders reported that they had a computer in their home, a higher percentage than the international average of 45 percent (figure 33). Fifty-nine percent of U.S. eighth-grade students reported having Internet access at home,

Figure 33.—Eighth-grade students' reports of access to computers and the Internet: 1999



◆Significant difference between U.S. average and international average in this category.

NOTE: Eighth grade in most nations. See appendix 2 for details.
The international average is the average of the national averages of the nations that reported data.

SOURCE: Martin et al. (2000). *TIMSS 1999 International Science Report: Findings from IEA's Repeat of the Third International Mathematics and Science Study at the Eighth Grade.* Exhibits R1.1 and 6.17. Chestnut Hill, MA: Boston College.

76 percent reported access at school, and 81 percent reported access elsewhere (e.g., libraries or community centers); all of these percentages were greater than the international averages.

Access to computers, software, and the Internet and, by extension, their use in and for mathematics and science lessons, can be affected by shortages of these tools at school. Schools of 47 percent of U.S. eighth-grade students reported that shortages of computers for instruction affected mathematics instruction "some" or "a lot," similar to the international average of 57 percent. Schools of 45 percent of U.S. eighth-grade students also reported that shortages of computers for instruction affected science instruction "some" or "a lot," a smaller percentage than the international average of 59 percent. In regard to computer software, schools of almost half of U.S. eighth-grade students reported that shortages affected mathematics instruction and science instruction "some or a lot" (48 percent and 47 percent, respectively), which were similar to the international averages.

U.S. eighth-grade students were more than twice as likely as their peers in other nations to be in schools with networked computer access to the Internet. Ninety-one percent of U.S. eighth-grade students were in schools that reported Internet access, a higher percentage than the international average of 41 percent. Internationally, an average of 29 percent of students were in schools that reported they had no Internet access at all and no plans to get it—more than a quarter of all students surveyed internationally. Less than 1 percent of U.S. eighth-grade students were enrolled in a school that reported no access to the Internet and no plans to obtain access.

Access to computers and the Internet is one thing, but using them is another. Eighth-grade students were asked how often they use computers in their mathematics and science classes, and how often their teachers use computers to demonstrate ideas in class.

Twelve percent of U.S. eighth-graders reported using computers in mathematics class "almost always" or "pretty often" in 1999, which was a higher percentage than the international average of 5 percent (figure 34). Sixty-one percent of U.S. eighth-grade students reported that they never used computers in their mathematics classes,

Figure 34.—Eighth-grade students' reports on using computers in mathematics and science classes "almost always" or "pretty often": 1999

◆Significant difference between U.S. average and international average in this category.

NOTE: Eighth grade in most nations. See appendix 2 for details.
The international average is the average of the national averages of the nations that reported data.

SOURCE: Martin et al. (2000). *TIMSS 1999 International Science Report: Findings from IEA's Repeat of the Third International Mathematics and Science Study at the Eighth Grade.* Exhibit 6.15. Chestnut Hill, MA: Boston College; Mullis et al. (2000). *TIMSS 1999 International Mathematics Report: Findings from IEA's Repeat of the Third International Mathematics and Science Study at the Eighth Grade.* Exhibit 6.18. Chestnut Hill, MA: Boston College.

which was below the international average of 80 percent. Nine percent of U.S. eighth-grade students reported that their teachers used computers to present mathematics ideas almost always or pretty often, which was higher than the international average of 5 percent.

Among U.S. eighth-graders who indicated access to the Internet, 13 percent reported they used e-mail to work with students in other schools on mathematics projects at least once a month, and 17 percent said that they used the World Wide Web to access information for mathematics projects at least once a month. A higher percentage of U.S. eighth-graders reported using the World Wide Web to access information for mathematics projects than the international average.

In science, 21 percent of U.S. eighth-graders reported using computers in science class "almost always" or "pretty often" in 1999, which was higher than the international average of 8 percent (figure 34).[11] Twenty percent of U.S. students reported their teachers used computers to present science ideas, which was higher than the international average of 10 percent.[12] Among U.S. eighth-grade students who indicated access to the Internet, 9 percent e-mailed students in other schools about science projects at least once a month, and 29 percent accessed information on the World Wide Web for science projects at least once a month. U.S. students' use of e-mail in this way for science-related projects was lower than the international average, and use of the Internet to access science information for science-related projects was higher than the international average.[13]

How often did U.S. students discuss completed homework or begin homework in their mathematics and science classes?

Many believe that homework is an important part of the learning process and that more homework leads to improvements in achievement. Prior TIMSS reports have not found a relationship between amount of homework assigned or hours spent on homework and achievement levels across nations (NCES, 1996, 1997c, 1998). That is, there was no consistent pattern of greater amounts of homework relating to higher achievement on TIMSS.

Homework can also be used to stimulate discussion in the classroom, however. TIMSS–R asked eighth-grade students how often they discuss their completed homework in their mathematics and science classes. A higher percentage of U.S. eighth-grade students reported that they discussed their completed homework during mathematics class than their international peers (figure 35). When asked whether they could begin their mathematics homework in class, a higher percentage of U.S. students reported that they could than students in 32 other nations. Seventy-four percent of U.S. eighth-graders reported that they "almost always" or "pretty often" could begin their mathematics homework during class compared to the international average of 42 percent.

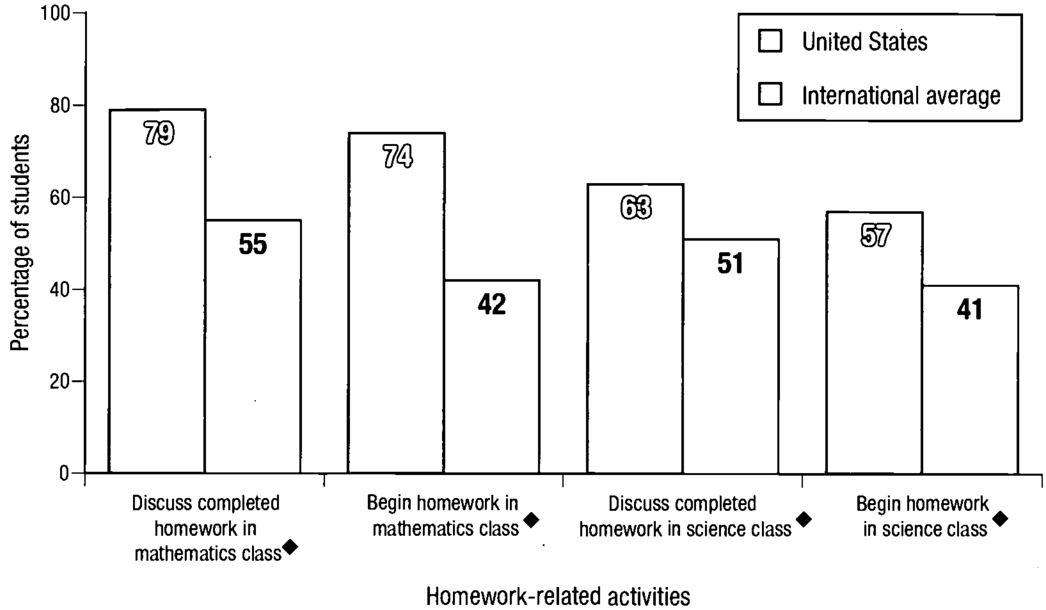
When compared to their peers in the 22 other nations that offer a general/integrated science curriculum, a higher percentage of U.S. eighth-grade students reported that they discussed their science homework in class than their peers in 15 nations. Sixty-three percent of U.S. eighth-graders reported that they "almost always" or "pretty often" discussed their completed science homework in class compared to the international average of 51 percent (figure 35). Among these same nations, the United States had a higher percentage of students who reported that they began their homework in science class than in 15 nations. Fifty-seven percent of U.S. eighth-grade students reported that they "almost always" or "pretty often" could begin their science homework during science class, compared to the international average of 41 percent.

[11]Comparisons among the 23 nations that generally teach general/integrated science.

[12]Comparisons among the 23 nations that generally teach general/integrated science.

[13]Comparisons among all 38 TIMSS–R nations.

Figure 35.—Eighth-grade students' reports of discussing or beginning homework in mathematics and science classes "almost always" or "pretty often": 1999



◆Significant difference between U.S. average and international average in this category.

NOTE: Eighth grade in most nations. See appendix 2 for details.
The international average is the average of the national averages of the nations that reported data.

SOURCE: Martin et al. (2000). *TIMSS 1999 International Science Report: Findings from IEA's Repeat of the Third International Mathematics and Science Study at the Eighth Grade.* Exhibit 6.10. Chestnut Hill, MA: Boston College; Mullis et al. (2000). *TIMSS 1999 International Mathematics Report: Findings from IEA's Repeat of the Third International Mathematics and Science Study at the Eighth Grade.* Exhibit 6.11. Chestnut Hill, MA: Boston College.

How much time did U.S. students spend studying mathematics or doing mathematics homework outside of school?

On average, U.S. eighth-grade students spent less time outside of school studying mathematics or science and doing mathematics or science homework than their international peers.[14] U.S. students spent an average of approximately three-quarters of an hour on a normal school day either studying mathematics or doing mathematics homework, which is lower than their international peers, who spent an average of 1 hour. U.S. students spent about half an hour on science outside of school, less time than their peers in all TIMSS–R nations, who spent an average of 1 hour.

[14]This finding is consistent with prior reports on TIMSS. In an earlier NCES (1996) report, comparisons were made among Germany, Japan, and the United States only. Data published in Beaton et al. (1996a, 1996b) are also consistent with the numbers reported here.

CHAPTER 4

FUTURE DIRECTIONS

The findings presented in this report examine the performance of U.S. eighth-grade students in comparison to their peers internationally. Most importantly, perhaps, this report documents the mathematics and science performance of our students between two points in time, a first for any international study. Regular participation in international data collections, such as TIMSS and TIMSS–R, provides an unprecedented opportunity to examine the pace of change in education in the United States and other nations over time, informing expectations of what can be achieved.

TIMSS and TIMSS–R were designed to document the mathematics and science performance of nations in comparison to one another. These studies were developed to document the systems put into place to support school mathematics and science teaching and learning in many different nations and the outcomes of these systems as measured on a set of items agreed upon at the international level. TIMSS and TIMSS–R were not specifically designed to indicate the success or failure of specific improvement efforts in the United States.

Of course, as with any study, the findings also raise many new questions, ones that can be pursued through future analyses of the TIMSS and TIMSS–R data, through analyses of other large-scale data sets such as NAEP, or through future data collections. This report presents an initial examination of the TIMSS and TIMSS–R data. Future reports are planned, and these will focus on more in-depth analyses of the data. In addition, each nation participating in TIMSS–R will release its own analysis of the data. Insights from each nation's findings can add to our understanding of what policies and practices may have contributed to observed changes in achievement. The TIMSS data set has been available for analysis by researchers, practitioners, and policymakers for some time. The TIMSS–R data set will also be made available in the first half of 2001. Finally, the results of the TIMSS–R Benchmarking Project involving 27 states, districts, and consortia of districts, available in April 2001, will provide an opportunity to examine eighth-grade mathematics and science achievement data at a more local level.

Among the many questions raised by the findings in this report are the following:

- ☐ Why did U.S. students' performance relative to the international average decrease as grade levels increase? What is happening in the intervening years between the fourth and eighth grades in the United States?
- ☐ Has the educational context for mathematics and science changed in the United States between 1995 and 1999?
- ☐ What education-related background factors are related to high achievement across nations? What education-related background factors are related to changes in achievement across nations over time?
- ☐ What is the relationship between performance in mathematics and performance in science at the student, school, and national levels?
- ☐ What is the relationship between international benchmarks of performance (e.g., top 10 percent) and the actual assessment items? Which items are students at or above the international top 10 percent benchmark likely to answer correctly? Which items are students at or above the international top 25 percent benchmark likely to answer correctly?
- ☐ In what areas of mathematics have black students in the United States been making progress? How does this progress relate to policies at the national, state, and local levels?
- ☐ What are possible reasons for the achievement gap in science between girls and boys in TIMSS–R? Did girls and boys differ in achievement on the content areas? How do these findings relate to decisions made at the national, state, and local levels?
- ☐ When controlling for other factors, how do different groups of U.S. students perform on TIMSS–R?
- ☐ What policies and practices have been instituted in nations that experienced significant increases and in those that experienced significant decreases in achievement? What is the relationship between these policies and practices and achievement?

Of course, there are many other questions that a study such as this raises. And some of the questions raised cannot be answered solely by examining data from TIMSS and TIMSS–R. It is expected, however, that further analyses of TIMSS and TIMSS–R will help address many of these questions and raise new ones to be pursued in future data collections. The additional components of TIMSS–R—that is, the TIMSS–R Videotape Classroom Study, the TIMSS–R Benchmarking Project, and the NAEP/TIMSS–R Linking Study—will add to the rich resources available for analysis and reflection. Moreover, it is hoped that TIMSS–R, including these component studies, will continue to stimulate discussion of the state of mathematics and science teaching and learning in the United States among researchers, policymakers, practitioners, parents, and students, much as TIMSS did.

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Stigler, J.W., Gonzales, P., Kawanaka, T., Knoll, S., and Serrano, A. (1999). *The TIMSS Videotape Classroom Study: Methods and Findings from an Exploratory Research Project on Eighth-Grade Mathematics Instruction in Germany, Japan, and the United States* (NCES 1999–074). Washington, DC: U.S. Government Printing Office.

Welch, C.M. (2000). United States. In D.F. Robitaille, A.F. Beaton, and T. Plomp (Eds.), *The Impact of TIMSS on the Teaching and Learning of Mathematics and Science* (pp. 161–167). Vancouver, BC: Pacific Educational Press.

Williams, T.H. and Carpenter, P.G. (1990). Private Schooling and Public Achievement. *Australian Journal of Education*, 34 (1), 3–24.

Wilson, W.J. (1987). *The Truly Disadvantaged: The Inner City, the Underclass, and Public Policy.* Chicago: University of Chicago Press.

Wilson, W.J. (1996). When Work Disappears. *Political Science Quarterly*, 111, 567–595.

Appendix 1

TIMSS Publications

The following reports are intended to serve as examples of some of the numerous publications that have been produced in relation to the 1995 Third International Mathematics and Science Study (TIMSS). For an extended version of this list, please visit the NCES TIMSS web site at http://nces.ed.gov/timss/timss95.

TIMSS Summary and Achievement Reports

Beaton, A.E., Martin, M.O., Mullis, I.V.S., Gonzalez, E.J., Smith, T.A., and Kelly, D.L. (1996). *Science Achievement in the Middle School Years: IEA's Third International Mathematics and Science Study*. Chestnut Hill, MA: Boston College.

Beaton, A.E., Mullis, I.V.S., Martin, M.O., Gonzalez, E.J., Kelly, D.L., and Smith, T.A. (1996). *Mathematics Achievement in the Middle School Years: IEA's Third International Mathematics and Science Study*. Chestnut Hill, MA: Boston College.

Martin, M.O., Mullis, I.V.S., Beaton, A.E., Gonzalez, E.J., Smith, T.A., and Kelly, D.L. (1997). *Science Achievement in the Primary School Years: IEA's Third International Mathematics and Science Study*. Chestnut Hill, MA: Boston College.

Mullis, I.V.S., Martin, M.O., Beaton, A.E., Gonzalez, E.J., Kelly, D.L., and Smith, T.A. (1997). *Mathematics Achievement in the Primary School Years: IEA's Third International Mathematics and Science Study*. Chestnut Hill, MA: Boston College.

Mullis, I.V.S., Martin, M.O., Beaton, A.E., Gonzalez, E.J., Kelly, D.L., and Smith, T.A. (1998). *Mathematics and Science Achievement in the Final Year of Secondary School: IEA's Third International Mathematics and Science Study*. Chestnut Hill, MA: Boston College.

National Center for Education Statistics, United States Department of Education. (1996). *Pursuing Eexcellence: A Study of U.S. Eighth-Grade Mathematics and Science Teaching, Learning, Curriculum, and Achievement in International Context* (NCES 97–198). Washington, DC: U.S. Government Printing Office.

National Center for Education Statistics, United States Department of Education. (1997). *Pursuing Excellence: A Study of U.S. Fourth-Grade Mathematics and Science Achievement in International Context* (NCES 97–255). Washington, DC: U.S. Government Printing Office.

National Center for Education Statistics, United States Department of Education. (1998). *Pursuing Excellence: A Study of U.S. Twelfth-Grade Mathematics and Science Achievement in International Context* (NCES 98–049). Washington, DC: Government Printing Office.

National Center for Education Statistics, United States Department of Education. (1999). *Highlights from TIMSS* (NCES 1999–081). Washington, DC: U.S. Government Printing Office.

National Center for Education Statistics, United States Department of Education. (2000). *Mathematics and Science in the Eighth Grade: Findings from the Third International Mathematics and Science Study* (NCES 2000–014). Washington, DC: U.S. Government Printing Office.

TIMSS Resource Kit

United States Department of Education. Office of Educational Research and Improvement. (1997). *Attaining Excellence: A TIMSS Resource Kit* (ORAD 97–1010). Washington, DC: U.S. Government Printing Office.

Office of Educational Research and Improvement, United States Department of Education (1999). *Attaining Excellence: TIMSS as a Starting Point to Examine Mathematics Assessments* (ORAD 1999–1104). Washington, DC: U.S. Government Printing Office.

TIMSS Videotape Classroom Study Reports

National Center for Education Statistics, United States Department of Education. (2000). *Highlights from the TIMSS Videotape Classroom Study* (NCES 2000–094). Washington, DC: U.S. Government Printing Office.

Stigler, J.W., Gonzales, P., Kawanaka, T., Knoll, S., and Serrano, A. (1999). *The TIMSS Videotape Classroom Study: Methods and Findings from an Exploratory Research Project on Eighth-Grade Mathematics Instruction in Germany, Japan, and the United States* (NCES 1999–074). Washington, DC: U.S. Government Printing Office.

TIMSS Curriculum Study Reports

Schmidt, W.H., McKnight, C.C., Cogan, L.C., Jakwerth, P.M., and Houang, R.T. (1999). *Facing the Consequences: Using TIMSS for a Closer Look at U.S. Mathematics and Science Education.* Dordrecht, Netherlands: Kluwer Academic Publishers.

Schmidt, W.H., McKnight, C.C., and Raizen, S.A. (1997). *A Splintered Vision: An Investigation of U.S. Science and Mathematics Education.* Dordrecht, Netherlands: Kluwer Academic Publishers.

Schmidt, W.H., McKnight, C.C., Valverde, G.A., Houang, R.T., and Wiley, D.E. (1997). *Many Visions, Many Aims Volume 1: A Cross-National Investigation of Curricular Intentions in School Mathematics.* Dordrecht, Netherlands: Kluwer Academic Publishers.

Schmidt, W.H., Raizen, S.A., Britton, E.D., Bianchi, L.J., and Wolfe, R.G. (1997). *Many Visions, Many Aims Volume 2: A Cross-National Investigation of Curricular Intentions in School Science.* Dordrecht, Netherlands: Kluwer Academic Publishers.

TIMSS Case Study Reports

Office of Educational Research and Improvement, United States Department of Education (1998). *The Educational System in Japan: Case Study Findings* (SAI 98–3008). Washington, DC: U.S. Government Printing Office.

Office of Educational Research and Improvement, United States Department of Education. (1998). *The Educational System in Germany: Case Study Findings* (SAI 1999–3001). Washington, DC: U.S. Government Printing Office.

Office of Educational Research and Improvement, United States Department of Education (1998). *The Educational System in the United States: Case Study Findings* (SAI 1999–3000). Washington, DC: U.S. Government Printing Office.

Policy Publications Resulting from TIMSS

National Research Council. (1999). *Global Perspectives for Local Action: Using TIMSS to Improve U.S. Mathematics and Science Education.* Washington, DC: National Academy Press.

Office of Educational Research and Improvement, United States Department of Education (1998). *Policy Brief: What the Third International Mathematics and Science Study (TIMSS) Means for Systemic School Improvement.* Washington, DC: U.S. Government Printing Office.

Silver, E.A. (1998). *Improving Mathematics in Middle School: Lessons from TIMSS and Related Research* (ORAD 98–1107). Washington, DC: U.S. Government Printing Office.

Wilson, L.D. and Blank, R.K. (1999). *Improving Mathematics Education Using Results from NAEP and TIMSS.* Washington, DC: Council of Chief State School Officers.

Appendix 2

Technical Notes

Sampling Information

TIMSS–R nations were asked to identify eligible students based on a common set of criteria, allowing for adaptation to nation-specific situations. The international desired population consisted of all students in the nation who were enrolled in the upper of the two adjacent grades that contained the greatest proportion of thirteen-year-olds at the time of testing. In the United States and most other nations, this corresponds to grade 8. If the national desired population of a nation fell below 65 percent, the nation's name is annotated to reflect this fact (table A2.1).

The international guidelines specified the following sampling standards:

- ☐ The sample was to be representative of at least 90 percent of students in the total population eligible for the study. Therefore, national exclusion rates were required to be less than 10 percent.
- ☐ The school participation rate without the use of replacement schools were required to be at least 50 percent, <u>and</u>
- ☐ School and student participation rates (after replacements) were required to be 85 percent <u>or</u>
- ☐ The combined participation rate (the product of school and student participation rates after replacements) were required to be at least 75 percent.

Nations were also required to submit a sampling plan for approval by the TIMSS International Study Center.

All deviations from the international guidelines are bolded in table A2.1.

A Note on U.S. Exclusion Rates

The reported exclusion rate for the United States for grade 8 TIMSS was 1.7 percent, and 3.9 percent for TIMSS–R. The difference in the exclusion rate for the United States between TIMSS and TIMSS–R may be explained as a difference in reporting procedures between the two studies, rather than an increase in the number of students declared not eligible to participate in the TIMSS–R assessment.

For the four nations that sampled more than one classroom per school, including the United States, exclusion of students could have occured at three levels: at the school level, at the classroom level, and at the student level. In the United States, there was negligible exclusion at the school level in both TIMSS and TIMSS–R. Tracking procedures accounted for exclusions of students within selected classes, but did not account for whole classroom exclusion. Thus, the reported U.S. TIMSS grade 8 exclusion rate of 1.7 percent covered only student-within-classroom exclusions, not whole classroom exclusions. It is likely, therefore, that this represents an underestimate of the overall exclusion rate.

For TIMSS–R, reporting procedures for exclusion rates in the United States were revised to permit tracking of excluded classrooms. Thus, the United States reports an exclusion rate within classrooms of 1.1 percent and a classroom exclusion rate of 2.8 percent in TIMSS–R, for a total within-school exclusion rate of 3.9 percent. The U.S. TIMSS–R exclusion rate is consistent with experience in the National Assessment of Educational Progress (NAEP) when accommodations are not offered. The available evidence thus points to no real change in the level of exclusion for the United States in TIMSS–R compared to TIMSS.

Weighting, Scaling and Plausible Values

Before the data were analyzed, responses from the groups of students assessed were assigned sampling weights to ensure that their representation in TIMSS–R results matched their actual percentage of the school population in the grade assessed. Based on these sampling weights, the analyses of TIMSS–R data were conducted in two major phases—scaling and estimation. During the scaling phase, item response theory (IRT) procedures were used to estimate the measurement characteristics of each assessment question. During the estimation phase, the results of the scaling were used to produce estimates of student achievement. Subsequent analyses related these achievement results to the background variables

Table A2.1.—Coverage of target population, by nation: 1999

Nation	Years of formal schooling	International desired population coverage	National desired population overall exclusion	School participation rate before replacement	Combined participation rate	Notes on sampling standards
Australia	8 or 9	100	2.5	84	85	
Belgium-Flemish	8	100	0.8	71	88	
Bulgaria	8	100	4.6	96	93	
Canada	8	100	6.0	94	93	
Chile	8	100	2.8	98	96	
Chinese Taipei	8	100	1.6	100	99	
Cyprus	8	100	0.8	100	97	
Czech Republic	9	100	5.2	96	95	
England	9	100	5.0	51	78	
Finland	7	100	3.7	97	96	
Hong Kong SAR	8	100	0.8	75	75	
Hungary	8	100	4.3	98	93	
Indonesia	8	100	0.0	88	97	
Iran, Islamic Republic of	8	100	4.4	96	98	
(Israel)	8	100	16.1	99	94	Exclusion rate over 10 percent
Italy	8	100	6.7	94	97	
Japan	8	100	1.3	93	89	
Jordan	8	100	3.0	99	99	
Korea	8	100	4.0	100	100	
Latvia-LSS[1]	8	61	4.0	97	91	Exclusion of 39 percent of student population (non-Latvian-speaking students)
Lithuania[2]	8.5	87	4.5	100	88	Exclusion of 13 percent of student population (non-Lithuanian-speaking students)
Macedonia, Republic of	8	100	1.1	99	98	
Malaysia	8	100	4.6	99	99	
Moldova	9	100	2.3	97	98	
Morocco	7	100	1.0	99	93	
Netherlands	8	100	0.6	58	82	
New Zealand	8.5 to 9.5	100	2.4	93	91	
Philippines	7	100	3.2	99	93	
Romania	8	100	3.7	98	97	
Russian Federation	7 or 8	100	1.7	98	96	
Singapore	8	100	0.0	100	98	
Slovak Republic	8	100	7.2	95	95	
Slovenia	8	100	3.0	98	94	
South Africa	8	100	2.3	84	82	
Thailand	8	100	3.3	95	99	
Tunisia	8	100	0.1	85	98	
Turkey	8	100	1.9	99	99	
United States	8	100	3.9	82	84	

[1]Designated LSS because only Latvian-speaking schools were tested.

[2]Lithuania tested the same cohort of students as other nations, but later in 1999, at the beginning of the next school year.

SOURCE: Mullis et al. (2000). *TIMSS 1999 International Mathematics Report: Findings from IEA's Repeat of the Third International Mathematics and Science Study at the Eighth Grade.* Exhibits 2, A.5, and A.8. Chestnut Hill, MA: Boston College.

Table A2.2.—Student and school samples and participation rates, by nation: 1999

Nation	Sample of schools	Sample of students	School participation after replacement (weighted)	Student participation (weighted)
Australia	170	4032	93	90
Belgium-Flemish	135	5259	89	97
Bulgaria	163	3272	97	96
Canada	385	8770	95	96
Chile	185	5907	100	96
Chinese Taipei	150	5772	100	99
Cyprus	61	3116	100	97
Czech Republic	142	3453	100	96
England	128	2960	85	90
Finland	159	2920	100	96
Hong Kong SAR	137	5179	76	98
Hungary	147	3183	98	95
Indonesia	150	5848	100	97
Iran, Islamic Republic of	170	5301	100	98
(Israel)	139	4195	100	94
Italy	180	3328	100	97
Japan	140	4745	93	95
Jordan	147	5052	100	99
Korea	150	6114	100	100
Latvia-LSS[1]	145	2873	98	93
Lithuania[2]	150	2361	100	89
Macedonia, Republic of	149	4023	99	98
Malaysia	150	5577	100	99
Moldova	150	3711	100	98
Morocco	173	5402	99	92
Netherlands	126	2962	85	95
New Zealand	152	3613	97	94
Philippines	150	6601	100	92
Romania	147	3425	98	98
Russian Federation	189	4332	100	97
Singapore	145	4966	100	98
Slovak Republic	145	3497	96	98
Slovenia	149	3109	99	95
South Africa	194	8146	91	93
Thailand	150	5732	100	99
Tunisia	149	5051	100	98
Turkey	204	7841	100	99
United States	221	9072	90	94

[1]Designated LSS because only Latvian-speaking schools were tested which represents 61 percent of the population.
[2]Lithuania tested the same cohort of students as other nations, but later in 1999, at the beginning of the next school year.
SOURCE: Mullis et al. (2000). *TIMSS 1999 International Mathematics Report: Findings from IEA's Repeat of the Third International Mathematics and Science Study at the Eighth Grade.* Exhibits A.6, A.7, and A.8. Chestnut Hill, MA: Boston College.

collected by TIMSS–R. TIMSS–R data are extremely important in terms of the cost to obtain them and the reliance placed on the reports that use them. Therefore, the scaling and analysis of these data were carefully conducted and include extensive quality control checks.

Weighting—Responses from the groups of students were assigned sampling weights to adjust for over-representation or under-representation from a particular group. For example, the United States desired to report information on the achievement of students in public and nonpublic schools. This required that the United States over-sample nonpublic school students to get enough information for this group of students in order to do that. Sampling weights were applied to the data for public and nonpublic students in order to ensure that the U.S. student sample represents the overall eighth-grade student population. The use of sampling weights is necessary for the computation of statistically sound, nationally-representative estimators. The weight assigned to a student's responses is the inverse of the probability that the student would be selected for the sample.

When responses are weighted, none are discarded, and each contributes to the results for the total number of students represented by the individual student assessed. Weighting also adjusts for various situations such as school and student nonresponse because data cannot be assumed to be randomly missing. The internationally-defined weighting specifications for TIMSS–R require that each assessed student's sampling weight should be the product of (1) the inverse of the school's probability of selection, (2) an adjustment for school-level nonresponse, (3) the inverse of the classroom's probability of selection, and (4) an adjustment for student-level nonresponse. All TIMSS–R analyses are conducted using these sampling weights.

Scaling—TIMSS–R used Item Response Theory (IRT) methods to produce score scales that summarized the achievement results. With this method, the performance of a sample of students in a subject area or sub-area could be summarized on a single scale or a series of scales, even when different students had been administered different items. Because of the reporting requirements for TIMSS–R and because of the large number of background variables associated with the assessment, a large number of analyses had to be conducted. The procedures TIMSS–R used for the analyses were developed to produce accurate results for groups of students while limiting the testing burden on individual students. Furthermore, these procedures provided data that could be readily used in secondary analyses. IRT scaling provides estimates of item parameters (e.g., difficulty, discrimination) that define the relationship between the item and the underlying variable measured by the test. Parameters of the IRT model are estimated for each test question, with an overall scale being established as well as scales for each predefined content area specified in the assessment framework. For example, in 1999 the TIMSS–R assessment had five scales describing mathematics content strands, and science had scales for six fields of science.

TIMSS 1995 utilized a one parameter IRT model to produce score scales that summarized the achievement results. The TIMSS data were rescaled using a three parameter IRT model, to match the procedures used to scale the 1999 TIMSS–R data. The move from a one parameter model to a three parameter model was initiated to provide better estimates of student achievement. After careful study of the rescaling process, the International Study Center concluded that the fit between the original TIMSS data and the rescaled TIMSS data met acceptable standards. However, as a result of rescaling, the average achievement scores of some nations changed from those initially reported in 1996 (NCES 1996) and 1997 (NCES, 1997c). The rescaled TIMSS scores are reported here.

Plausible Values—During the scaling phase, plausible values were used to characterize scale scores for students participating in the assessment. To keep student burden to a minimum, TIMSS–R administered few assessment items to each student—too few to produce accurate content-related scale scores for each student. To account for this, for each student TIMSS–R generated five possible content-related scale scores that represented selections from the distribution of content-related scale scores of students with similar backgrounds who answered the assessment items the same way. The plausible-values technology is one way to ensure that the estimates of the average performance of student populations and the estimates of variability in those estimates are more accurate than those determined through traditional procedures, which estimate a single score for each student. During the construction of plausible values, careful quality control steps ensured that the subpopulation estimates based on these plausible values were accurate. Plausible values were constructed separately for each national sample.

TIMSS–R uses the plausible-values methodology to represent what the true performance of an individual might have been, had it been observed, using a small number of random draws from an empirically derived distribution of score values based on the student's observed responses to assessment items and on background variables. Each random draw from the distribution is considered a representative value from the distribution of potential scale scores for all students in the sample who have similar characteristics and identical patterns of item responses. The draws from the distribution are different from one another to quantify the degree of precision (the width of the spread) in the underlying distribution of possible scale scores that could have caused the observed performances. The TIMSS–R plausible values function like point estimates of scale scores for many purposes, but they are unlike true point estimates in several respects. They differ from one another for any particular student, and the amount of difference quantifies the spread in the underlying distribution of possible scale scores for that student. Because of the plausible-values approach, secondary researchers can use the TIMSS–R data to carry out a wide range of analyses.

Item Development and Replacement

TIMSS–R utilized the same assessment framework designed for TIMSS. Approximately one third of the original 1995 TIMSS assessment items were kept secure so that they could be included in the 1999 TIMSS–R assessment to provide trend data. For the approximately two thirds of items that were released to the public, a panel of international assessment and content experts and the National Research Coordinators (NRCs) of each participating country developed and reviewed replacement items that closely matched the content of the original items. Through this process, over 300 science and mathematics items were developed as potential replacement items, of which 277 items were carefully chosen to be field tested. Approximately 1000 students per country participated in this field test.

All of the potential replacement items and the secured items, as well as the questionnaires, were field tested in 31 nations. Field test results for each item were carefully reviewed and examined for problems. Items that did not perform well during the field test—based on a clear set of criteria—were either revised to correct the problem or set aside. Of the 277 potential replacement items, 202 were selected based on the results of the field test. The item development process resulted in the replacement of TIMSS items released to the public with new items that had similar characteristics in terms of item format, performance expectation, content area, and difficulty level.

As a result, the TIMSS–R assessments consisted of 298 items—96 non-released items and 202 replacement items, organized into 26 blocks of items among 8 test booklets. A summary of item characteristics in TIMSS and TIMSS–R is provided below.

Table A2.3.—Number of items by item format in main survey: 1995 and 1999

Response type	TIMSS	TIMSS–R
Multiple choice	227	230
Free response	59	68
Total	286	298

SOURCE: Boston College, Third International Mathematics and Science Study–Repeat (TIMSS–R), Field Test Report, Table 8.1, 1999.

Table A2.4.—Number of mathematics items by content area in main survey: 1995 and 1999

Content area	TIMSS	TIMSS–R
Algebra	27	28
Data representation, analysis and probability	21	21
Fractions and number sense	51	52
Geometry	23	23
Measurement	18	20
Proportionality	11	11*
Total	151	155

*Proportionality items in TIMSS–R distributed among other content areas. Therefore, TIMSS–R does not report proportionality as a separate content area.

SOURCE: Boston College, Third International Mathematics and Science Study–Repeat (TIMSS–R), Field Test Report, Table 8.2, 1999.

Table A2.5.—Number of science items by content area in main survey: 1995 and 1999

Content area	TIMSS	TIMSS–R
Chemistry	19	19
Earth science	22	22
Life science	40	39
Physics	40	39
Environmental and resource issues *	6	12
Scientific inquiry and the nature of science*	8	12
Total	135	143

*The TIMSS–R Science Assessment reflects the inclusion of 10 new items in the areas of Environmental and Resource Issues and Scientific Inquiry and the Nature of Science. This will permit the results in these two content areas to be reported separately in TIMSS–R, which was not the case in TIMSS.

SOURCE: Boston College, Third International Mathematics and Science Study–Repeat (TIMSS–R), Field Test Report, Table 8.3, 1999.

TRANSLATION VERIFICATION

The TIMSS–R instruments were prepared in English and translated into the primary language or languages of instruction in each nation. In addition, it was sometimes necessary to adapt the instruments for cultural purposes, even in the nations that tested in English. Adaptations were approved by the International Study Center if they did not in any way change the substance or intent of the question or answer choices. For example, use of the word "weight" may be an unfamiliar colloquial term for "mass" to some students; a change from "weight" to "weight (mass)" would be an acceptable clarification in this case.

Each nation prepared translations of the instruments according to translation guidelines established by the International Study Center. Adaptations to the instruments were documented by each nation. The goal of the translation guidelines was to produce translated instruments of the highest quality that would provide comparable data across participating nations.

Translated instruments were verified by an independent, professional translation agency prior to final approval and printing of the instruments. Nations were required to submit copies of the final printed instruments administered in TIMSS–R to the International Study Center. Further details on the translation process can be found in the *TIMSS 1999 Technical Report* (Martin and Gregory, 2000).

ITEM SCORING

The TIMSS–R assessments items included both multiple choice and free-response items. The National Research Coordinator (NRC) in each nation was responsible for the scoring and coding of data in that nation, following established international guidelines. The NRC and, in some cases, additional staff, attended in-depth training sessions to introduce participants to the TIMSS–R coding system and to provide extensive practice in scoring example items. The training sessions were generally conducted over several days. Information on within-country agreement among coders was collected and documented by the International Study Center. A percentage of student responses in each nation were to be scored independently by two coders. Information on coding and scoring reliability was also used to calculate cross-country agreement among the coders. The International Study Center carefully monitored and documented the reliability of scoring within and across nations. The results of calculating reliability on scoring of the free-response items in each nation can be found in Martin et al. (2000) and Mullis et al. (2000). Further details on the item scoring process can be found in Martin and Gregory (2000).

TIMSS 1995 PARTICIPATING NATIONS

Table A2.6 describes the complete list of nations that participated in TIMSS 1995 at the fourth and eighth grades.

Table A2.6.—Fourth- and eighth-grade nations in TIMSS: 1995

	Nations that participated in TIMSS at eighth grade (1995)	Nations that participated in TIMSS at fourth grade (1995)
	(Australia)	(Australia)
	(Austria)	(Austria)
	Belgium-Flemish	
	(Belgium-French)	
	(Bulgaria)	
	Canada	Canada
	(Colombia)	
	Cyprus	Cyprus
	Czech Republic	Czech Republic
	(Denmark)	
	(England)	(England)
	France	
	(Germany)	
	(Greece)	Greece
	Hong Kong SAR	Hong Kong SAR
	Hungary	(Hungary)
	Iceland	Iceland
	Iran, Islamic Republic of	Iran, Islamic Republic of
	Ireland	Ireland
	(Israel)	(Israel)
	(Italy)[1]	(Italy)[1]
	Japan	Japan
	Korea, Republic of	Korea, Republic of
	(Kuwait)	(Kuwait)
	(Latvia-LSS)[2]	(Latvia-LSS)[2]
	(Lithuania)[3]	
	(Netherlands)	(Netherlands)
	New Zealand	New Zealand
	Norway	Norway
	Portugal	Portugal
	(Romania)	
	Russian Federation	
	(Scotland)	Scotland
	Singapore	Singapore
	Slovak Republic	
	(Slovenia)	(Slovenia)
	(South Africa)	
	Spain	
	Sweden	
	Switzerland	
	(Thailand)	(Thailand)
	United States	United States
Total Nations	42	27

[1]Italy was unable to provide the International Study Center at Boston College with their data in time for it to be included in the international reports for both the fourth and eighth grade in TIMSS 1995. However, their data for TIMSS 1995 appear in this report.

[2]Designated LSS because only Latvian-speaking schools were tested.

[3]Lithuania tested the same cohort of students as other nations, but later in 1999, at the beginning of the next school year.

NOTE: Only nations that completed the necessary steps for their data to appear in the reports from the International Study Center at Boston College are listed.

Parentheses indicate nations not meeting international sampling and/or other guidelines at fourth, eighth or both grades in 1995. See NCES (1996) for details regarding eighth-grade data. See NCES (1997c) for details for fourth-grade data.

SOURCE: Mullis et al. (2000). *TIMSS 1999 International Mathematics Report: Findings from IEA's Repeat of the Third International Mathematics and Science Study at the Eighth Grade.* Exhibit A.1. Chestnut Hill, MA: Boston College.

Appendix 3

Supporting Data for Chapter 2

Table A3.1.—Average mathematics and science achievement of eighth-grade students with standard errors, by nation: 1999

Mathematics			Science		
Nation	Average	s.e.	Nation	Average	s.e.
Australia	525	4.8	Australia	540	4.4
Belgium-Flemish	558	3.3	Belgium-Flemish	535	3.1
Bulgaria	511	5.9	Bulgaria	518	5.4
Canada	531	2.5	Canada	533	2.1
Chile	392	4.4	Chile	420	3.7
Chinese Taipei	585	4.0	Chinese Taipei	569	4.4
Cyprus	476	1.8	Cyprus	460	2.4
Czech Republic	520	4.2	Czech Republic	539	4.2
England	496	4.2	England	538	4.8
Finland	520	2.7	Finland	535	3.5
Hong Kong SAR	582	4.3	Hong Kong SAR	530	3.7
Hungary	532	3.7	Hungary	552	3.7
Indonesia	403	4.9	Indonesia	435	4.5
Iran, Islamic Republic of	422	3.4	Iran, Islamic Republic of	448	3.8
(Israel)	466	3.9	(Israel)	468	4.9
Italy	479	3.8	Italy	493	3.9
Japan	579	1.7	Japan	550	2.2
Jordan	428	3.6	Jordan	450	3.8
Korea, Republic of	587	2.0	Korea, Republic of	549	2.6
Latvia-LSS[1]	505	3.4	Latvia-LSS[1]	503	4.8
Lithuania[2]	482	4.3	Lithuania[2]	488	4.1
Macedonia, Republic of	447	4.2	Macedonia, Republic of	458	5.2
Malaysia	519	4.4	Malaysia	492	4.4
Moldova	469	3.9	Moldova	459	4.0
Morocco	337	2.6	Morocco	323	4.3
Netherlands	540	7.1	Netherlands	545	6.9
New Zealand	491	5.2	New Zealand	510	4.9
Philippines	345	6.0	Philippines	345	7.5
Romania	472	5.8	Romania	472	5.8
Russian Federation	526	5.9	Russian Federation	529	6.4
Singapore	604	6.3	Singapore	568	8.0
Slovak Republic	534	4.0	Slovak Republic	535	3.3
Slovenia	530	2.8	Slovenia	533	3.2
South Africa	275	6.8	South Africa	243	7.9
Thailand	467	5.1	Thailand	482	4.0
Tunisia	448	2.4	Tunisia	430	3.4
Turkey	429	4.3	Turkey	433	4.3
United States	502	4.0	United States	515	4.6
International average of 38 nations	487	0.7	International average of 38 nations	488	0.7

[1]Designated LSS because only Latvian-speaking schools were tested which represents 61 percent of the population.

[2]Lithuania tested the same cohort of students as other nations, but later in 1999, at the beginning of the next school year.

NOTE: Eighth grade in most nations. See appendix 2 for details.
Parentheses indicate nations not meeting international sampling and/or other guidelines. See appendix 2 for details.
The international average is the average of the national averages of the 38 nations.
s.e. means standard error.

SOURCE: Martin et al. (2000). *TIMSS 1999 International Science Report: Findings from IEA's Repeat of the Third International Mathematics and Science Study at the Eighth Grade.* Exhibit 1.1. Chestnut Hill, MA: Boston College; Mullis et al. (2000). *TIMSS 1999 International Mathematics Report: Findings from IEA's Repeat of the Third International Mathematics and Science Study at the Eighth Grade.* Exhibit 1.1. Chestnut Hill, MA: Boston College.

Table A3.2.—Percentiles of achievement in eighth-grade mathematics with standard errors, by nation: 1999

Nation	Percentages of students reaching international benchmarks							
	Top 10 percent		Top 25 percent		Top 50 percent		Top 75 percent	
	Percent	s.e.	Percent	s.e.	Percent	s.e.	Percent	s.e.
Australia	12	1.8	37	2.7	73	2.4	94	0.8
Belgium-Flemish	23	1.4	54	1.7	85	1.4	98	0.7
Bulgaria	11	2.3	30	3.0	66	2.6	91	1.3
Canada	12	1.1	38	1.5	77	1.3	96	0.6
Chile	1	0.5	3	1.1	15	1.8	48	2.0
Chinese Taipei	41	1.7	66	1.5	85	1.0	95	0.6
Cyprus	3	0.4	17	0.8	51	1.1	84	0.8
Czech Republic	11	1.4	33	2.1	69	2.3	94	1.1
England	7	0.9	24	1.9	58	2.1	89	1.3
Finland	6	0.9	31	1.7	75	1.5	96	0.5
Hong Kong SAR	33	2.3	68	2.4	92	1.5	99	0.6
Hungary	16	1.2	41	1.9	74	1.6	94	1.0
Indonesia	2	0.4	7	0.9	22	1.4	52	2.2
Iran, Islamic Republic of	1	0.2	5	0.8	25	1.7	63	1.5
(Israel)	5	0.6	18	1.3	47	1.8	77	1.9
Italy	5	0.7	20	1.4	52	2.1	83	1.4
Japan	33	1.1	64	1.0	89	0.5	98	0.3
Jordan	3	0.5	11	0.9	32	1.5	62	1.4
Korea, Republic of	37	1.0	68	0.9	91	0.5	99	0.2
Latvia-LSS[1]	7	0.9	26	1.8	63	2.0	92	1.0
Lithuania[2]	4	0.7	17	2.0	52	2.4	86	1.8
Macedonia, Republic of	3	0.4	12	1.0	38	1.9	72	1.8
Malaysia	12	1.4	34	2.4	69	2.2	94	0.8
Moldova	4	0.7	16	1.5	45	2.2	81	1.7
Morocco	0	0.0	0	0.2	5	0.4	27	1.1
Netherlands	14	2.3	45	4.1	81	3.5	96	1.3
New Zealand	8	1.2	25	2.4	56	2.5	85	1.5
Philippines	0	0.1	1	0.5	8	1.4	31	2.5
Romania	5	1.1	19	1.9	49	2.6	80	2.1
Russian Federation	15	1.8	37	2.8	72	2.7	94	1.2
Singapore	46	3.5	75	2.7	93	1.3	99	0.3
Slovak Republic	14	1.4	40	2.3	78	1.8	96	0.6
Slovenia	15	1.2	39	1.4	74	1.4	95	0.7
South Africa	0	0.2	1	0.4	5	1.0	14	2.0
Thailand	4	0.8	16	1.8	44	2.6	81	1.6
Tunisia	0	0.1	4	0.5	32	1.6	80	1.3
Turkey	1	0.3	7	1.0	27	1.9	65	2.0
United States	9	1.0	28	1.6	61	1.9	88	1.0

[1]Designated LSS because only Latvian-speaking schools were tested which represents 61 percent of the population.
[2]Lithuania tested the same cohort of students as other nations, but later in 1999, at the beginning of the next school year.

NOTE: Eighth grade in most nations. See appendix 2 for details.
Parentheses indicate nations not meeting international sampling and/or other guidelines. See appendix 2 for details.
s.e. means standard error.

SOURCE: Mullis et al. (2000). *TIMSS 1999 International Mathematics Report: Findings from IEA's Repeat of the Third International Mathematics and Science Study at the Eighth Grade.* Exhibit 1.6. Chestnut Hill, MA: Boston College.

Table A3.3.—Percentiles of achievement in eighth-grade science with standard errors, by nation: 1999

Nation	Percentages of students reaching international benchmarks							
	Top 10 percent		Top 25 percent		Top 50 percent		Top 75 percent	
	Percent	s.e.	Percent	s.e.	Percent	s.e.	Percent	s.e.
Australia	19	1.6	43	2.3	74	2.0	93	0.9
Belgium-Flemish	11	1.4	39	1.6	76	1.7	96	1.3
Bulgaria	14	2.1	34	2.5	65	2.2	88	1.5
Canada	14	0.9	38	1.3	73	1.2	94	0.6
Chile	1	0.4	5	1.0	22	1.6	56	1.7
Chinese Taipei	31	1.9	58	2.0	83	1.3	95	0.7
Cyprus	2	0.5	12	0.8	39	1.6	74	1.4
Czech Republic	17	1.7	41	2.2	74	1.8	95	0.8
England	19	1.9	42	2.3	72	2.0	92	1.0
Finland	14	1.4	39	1.9	74	1.5	95	0.7
Hong Kong SAR	10	1.1	35	2.1	75	2.1	95	1.0
Hungary	22	1.4	49	1.7	79	1.4	95	0.8
Indonesia	1	0.3	6	0.9	27	1.6	64	2.4
Iran, Islamic Republic of	2	0.3	9	1.0	32	1.7	68	1.7
(Israel)	7	0.6	20	1.2	45	1.9	72	2.0
Italy	7	0.9	23	1.7	54	2.0	83	1.2
Japan	19	1.1	48	1.4	80	1.0	96	0.5
Jordan	4	0.5	15	1.0	38	1.5	66	1.6
Korea, Republic of	22	1.1	46	1.2	77	1.0	94	0.5
Latvia-LSS[1]	7	1.3	24	2.5	59	2.0	88	1.4
Lithuania[2]	6	0.9	20	1.9	51	2.1	83	1.8
Macedonia, Republic of	4	0.5	15	1.6	40	1.9	70	2.2
Malaysia	6	0.9	21	1.9	53	2.2	85	1.5
Moldova	4	0.5	15	1.2	39	1.8	70	1.6
Morocco	0	0.0	1	0.2	5	0.5	20	1.1
Netherlands	16	2.3	46	3.8	79	3.5	95	1.6
New Zealand	12	1.4	32	2.1	61	2.2	86	1.6
Philippines	1	0.3	3	0.7	13	1.7	31	2.6
Romania	6	0.8	19	1.9	45	2.5	75	2.1
Russian Federation	17	2.4	38	2.8	68	2.5	90	1.0
Singapore	32	3.3	56	3.5	80	2.6	94	1.4
Slovak Republic	14	1.4	39	2.0	74	1.7	94	0.7
Slovenia	16	1.1	39	1.7	71	1.5	93	0.7
South Africa	0	0.2	2	0.6	6	1.4	13	2.0
Thailand	3	0.7	15	2.0	47	2.5	84	1.3
Tunisia	0	0.1	3	0.4	19	1.5	62	2.0
Turkey	1	0.2	6	0.8	25	1.8	62	2.4
United States	15	1.2	34	1.9	62	2.0	85	1.3

[1]Designated LSS because only Latvian-speaking schools were tested.

[2]Lithuania tested the same cohort of students as other nations, but later in 1999, at the beginning of the next school year.

NOTE: Eighth grade in most nations. See appendix 2 for details.

Parentheses indicate nations not meeting international sampling and/or other guidelines. See appendix 2 for details.

s.e. means standard error.

SOURCE: Martin et al. (2000). *TIMSS 1999 International Science Report: Findings from IEA's Repeat of the Third International Mathematics and Science Study at the Eighth Grade.* Exhibit 1.6. Chestnut Hill, MA: Boston College.

Table A3.4.—Average eighth-grade achievement in mathematics content areas with standard errors, by nation: 1999

Nation	Fractions and number sense: Average	s.e.	Measurement: Average	s.e.	Data representation, analysis, and probability: Average	s.e.	Geometry: Average	s.e.	Algebra: Average	s.e.
Australia	519	4.3	529	4.9	522	6.3	497	5.7	520	5.1
Belgium-Flemish	557	3.1	549	4.0	544	3.8	535	4.1	540	4.6
Bulgaria	503	6.6	497	6.6	493	6.1	524	5.9	512	5.1
Canada	533	2.5	521	2.4	521	4.5	507	4.7	525	2.4
Chile	403	4.9	412	4.9	429	3.8	412	5.4	399	4.3
Chinese Taipei	576	4.2	566	3.4	559	5.1	557	5.8	586	4.4
Cyprus	481	3.0	471	4.0	472	4.6	484	4.6	479	1.6
Czech Republic	507	4.8	535	5.0	513	5.9	513	5.5	514	4.0
England	497	3.8	507	3.8	506	8.0	471	4.2	498	4.9
Finland	531	3.8	521	4.7	525	3.8	494	6.0	498	3.1
Hong Kong SAR	579	4.5	567	5.8	547	5.4	556	4.9	569	4.5
Hungary	526	4.2	538	3.5	520	5.9	489	4.3	536	4.1
Indonesia	406	4.1	395	5.1	423	4.4	441	5.1	424	5.7
Iran, Islamic Republic of	437	4.5	401	4.7	430	6.0	447	2.9	434	4.9
(Israel)	472	4.4	457	5.1	468	5.1	462	5.4	479	4.5
Italy	471	5.0	501	5.0	484	4.5	482	5.6	481	3.6
Japan	570	2.6	558	2.4	555	2.3	575	5.1	569	3.3
Jordan	432	3.2	438	4.4	436	7.8	449	7.1	439	5.3
Korea, Republic of	570	2.7	571	2.8	576	4.2	573	3.9	585	2.7
Latvia-LSS[1]	496	3.7	505	3.5	495	4.8	522	5.6	499	4.3
Lithuania[2]	479	4.3	467	4.0	493	3.6	496	5.8	487	3.7
Macedonia, Republic of	437	4.7	451	5.2	442	6.2	460	6.1	465	4.0
Malaysia	532	4.7	514	4.6	491	4.0	497	4.4	505	4.8
Moldova	465	4.2	479	4.9	450	5.7	481	5.0	477	3.7
Morocco	335	3.6	348	3.5	383	3.5	407	2.2	353	4.7
Netherlands	545	7.1	538	5.8	538	7.9	515	5.5	522	7.7
New Zealand	493	5.0	496	5.3	497	5.0	478	4.2	497	4.7
Philippines	378	6.3	355	6.2	406	3.5	383	3.4	345	5.8
Romania	458	5.7	491	4.9	453	4.7	487	6.4	481	5.2
Russian Federation	513	6.4	527	6.0	501	4.8	522	6.0	529	4.9
Singapore	608	5.6	599	6.3	562	6.2	560	6.7	576	6.2
Slovak Republic	525	4.8	537	3.3	521	4.6	527	7.3	525	4.6
Slovenia	527	3.7	523	3.7	530	4.2	506	6.2	525	2.9
South Africa	300	6.0	329	4.8	356	3.8	335	6.6	293	7.7
Thailand	471	5.3	463	6.2	476	4.0	484	4.4	456	4.9
Tunisia	443	2.8	442	3.1	446	5.1	484	4.4	455	2.7
Turkey	430	4.3	436	6.5	446	3.3	428	5.7	432	4.6
United States	509	4.2	482	3.9	506	5.2	473	4.4	506	4.1
International average of 38 nations	487	0.7	487	0.7	487	0.7	487	0.7	487	0.7

[1]Designated LSS because only Latvian-speaking schools were tested which represents 61 percent of the population.

[2]Lithuania tested the same cohort of students as other nations, but later in 1999, at the beginning of the next school year.

NOTE: Eighth grade in most nations. See appendix 2 for details.

Parentheses indicate nations not meeting international sampling and/or other guidelines. See appendix 2 for details.

The international average is the average of the national averages of the 38 nations.

s.e. means standard error.

SOURCE: Mullis et al. (2000). *TIMSS 1999 International Mathematics Report: Findings from IEA's Repeat of the Third International Mathematics and Science Study at the Eighth Grade.* Exhibit 3.1. Chestnut Hill, MA: Boston College.

Table A3.5.—Average eighth-grade achievement in science content areas with standard errors, by nation: 1999

	Earth science		Life science		Physics		Chemistry		Environmental and resource issues		Scientific inquiry and the nature of science	
Nation	Average	s.e.	Average	s.e.	Average	s.e.	Average	s.e.	Average	s.e.	Average	s.e.
Australia	519	6.1	530	4.4	531	6.3	520	5.0	530	6.3	535	4.9
Belgium-Flemish	533	3.5	535	4.6	530	3.5	508	3.3	513	3.5	526	4.9
Bulgaria	520	5.7	514	6.9	505	5.8	527	5.7	483	6.4	479	5.6
Canada	519	3.7	523	3.8	521	3.8	521	5.4	521	3.5	532	5.1
Chile	435	7.0	431	3.7	428	5.6	435	5.2	449	4.8	441	4.7
Chinese Taipei	538	3.0	550	3.3	552	3.9	563	4.3	567	4.0	540	4.9
Cyprus	459	5.4	468	3.8	459	2.9	470	3.4	475	4.3	467	4.6
Czech Republic	533	6.9	544	4.1	526	4.2	512	5.2	516	5.7	522	5.7
England	525	3.9	533	6.2	528	4.5	524	5.5	518	5.8	538	5.1
Finland	520	5.5	520	4.0	520	4.4	535	4.5	514	7.1	528	4.0
Hong Kong SAR	506	4.3	516	5.5	523	4.9	515	5.2	518	4.9	531	2.8
Hungary	560	3.9	535	4.0	543	4.3	548	4.7	501	6.6	526	5.9
Indonesia	431	6.4	448	3.6	452	5.5	425	3.9	489	4.8	446	4.3
Iran, Islamic Republic of	459	5.2	437	3.7	445	5.7	487	4.1	470	5.5	446	5.3
(Israel)	472	5.2	463	4.0	484	5.3	479	4.7	458	4.0	476	8.3
Italy	502	5.9	488	4.6	480	4.1	493	4.8	491	5.4	489	4.6
Japan	533	6.2	534	5.4	544	2.9	530	3.1	506	5.5	543	2.8
Jordan	446	3.5	448	4.1	459	3.6	483	5.5	476	6.0	440	5.5
Korea, Republic of	532	2.7	528	3.6	544	5.1	523	3.7	523	4.5	545	7.3
Latvia-LSS[1]	495	5.4	509	3.9	495	3.9	490	3.7	493	5.2	495	4.7
Lithuania[2]	476	4.4	494	4.6	510	4.3	485	4.6	458	5.1	483	6.4
Macedonia, Republic of	464	4.2	468	4.9	463	6.0	481	6.1	432	4.2	464	3.6
Malaysia	491	4.2	479	5.4	494	4.1	485	3.5	502	4.4	488	4.5
Moldova	466	4.2	477	3.9	457	5.5	451	5.6	444	6.2	471	3.9
Morocco	363	3.3	347	2.8	352	4.2	372	4.8	396	5.1	391	4.2
Netherlands	534	7.2	536	7.2	537	6.5	515	6.4	526	8.5	534	6.5
New Zealand	504	5.8	501	5.6	499	4.7	503	4.9	503	5.2	521	6.8
Philippines	390	5.0	378	5.7	393	6.3	394	6.5	391	7.6	403	5.5
Romania	475	5.5	475	6.0	465	6.8	481	6.1	473	6.6	456	5.5
Russian Federation	529	5.1	517	6.5	529	6.3	523	8.0	495	6.6	491	4.9
Singapore	521	7.3	541	7.2	570	6.7	545	8.3	577	8.3	550	5.9
Slovak Republic	537	4.3	535	6.2	518	4.1	525	4.9	512	4.5	507	3.9
Slovenia	541	4.3	521	3.9	525	4.4	509	5.4	519	3.4	513	4.3
South Africa	348	4.8	289	7.3	308	6.7	350	4.0	350	8.5	329	6.4
Thailand	470	3.9	508	4.5	475	4.2	439	4.3	507	3.0	462	4.2
Tunisia	442	2.7	441	5.0	425	6.3	439	3.7	462	5.0	451	3.4
Turkey	435	4.6	444	4.5	441	4.0	437	5.0	461	3.6	445	6.3
United States	504	4.2	520	4.1	498	5.5	508	4.8	509	6.4	522	4.3
International average of 38 nations	488	0.9	488	0.7	488	0.9	488	0.8	488	0.7	488	0.7

[1]Designated LSS because only Latvian-speaking schools were tested which represents 61 percent of the population.

[2]Lithuania tested the same cohort of students as other nations, but later in 1999, at the beginning of the next school year.

NOTE: Eighth grade in most nations. See appendix 2 for details.
Parentheses indicate nations not meeting international sampling and/or other guidelines. See appendix 2 for details.
The international average is the average of the national averages of the 38 nations.
s.e. means standard error.

SOURCE: Martin et al. (2000). *TIMSS 1999 International Science Report: Findings from IEA's Repeat of the Third International Mathematics and Science Study at the Eighth Grade.* Exhibit 3.1. Chestnut Hill, MA: Boston College.

Table A3.6.—Percent correct on mathematics assessment item examples with standard errors, by nation: 1999

Nation	Percentage of students responding correctly									
	Figure 6		Figure 7		Figure 8		Figure 9		Figure 10	
	Percent	s.e.	Percent	s.e.	Percent	s.e.	Percent	s.e.	Percent	s.e.
Australia	91	0.8	55	1.8	29	2.0	36	2.3	37	2.4
Belgium-Flemish	96	0.7	65	2.0	42	1.7	70	2.7	62	1.9
Bulgaria	86	1.6	52	3.2	22	2.6	49	3.1	41	3.0
Canada	93	0.7	58	1.6	32	1.8	36	3.0	42	2.6
Chile	65	1.3	7	1.2	5	1.0	23	1.8	8	1.2
Chinese Taipei	89	0.7	75	1.4	50	1.8	61	1.8	66	1.7
Cyprus	85	1.1	41	1.9	21	1.8	30	3.1	34	1.8
Czech Republic	91	1.0	46	2.9	34	2.5	40	3.0	46	2.8
England	92	1.0	48	2.3	17	1.9	43	2.9	34	2.3
Finland	91	1.0	57	2.3	28	2.0	53	3.2	32	2.3
Hong Kong SAR	93	0.7	78	1.6	34	1.8	60	2.4	62	2.3
Hungary	93	0.9	45	2.0	35	2.1	39	2.4	46	2.0
Indonesia	54	1.6	20	1.4	5	0.5	22	1.7	14	1.2
Iran, Islamic Republic of	58	1.5	25	2.0	9	0.7	23	1.8	14	1.1
(Israel)	83	1.6	28	1.8	19	1.5	35	2.8	30	1.8
Italy	77	1.9	48	2.1	27	1.7	41	2.2	24	1.5
Japan	95	0.5	80	1.2	39	1.5	73	1.7	53	1.7
Jordan	66	1.5	26	1.5	12	1.1	35	2.2	13	1.3
Korea, Republic of	93	0.6	78	1.3	52	1.5	56	2.1	61	1.2
Latvia-LSS[1]	87	1.4	44	2.5	35	2.1	39	2.9	32	2.4
Lithuania[2]	84	1.5	35	2.4	25	2.0	35	3.0	23	2.1
Macedonia, Republic of	79	1.4	25	1.9	17	1.3	36	2.7	16	1.6
Malaysia	88	0.8	56	1.9	19	1.4	49	2.5	32	1.8
Moldova	66	1.6	38	2.6	16	1.8	40	3.0	26	1.9
Morocco	43	1.2	8	0.9	2	0.4	26	1.8	5	0.6
Netherlands	95	0.8	55	4.7	25	2.7	39	3.5	38	2.5
New Zealand	88	1.0	41	2.3	18	1.7	27	2.3	32	2.3
Philippines	53	1.6	6	1.0	3	0.7	13	1.4	9	0.9
Romania	73	1.8	43	2.7	20	2.2	48	3.2	38	3.0
Russian Federation	83	1.9	49	2.8	30	2.4	49	2.9	40	2.7
Singapore	97	0.5	83	1.5	57	2.1	67	2.4	72	2.5
Slovak Republic	90	1.1	57	2.5	36	2.3	49	2.9	53	3.0
Slovenia	92	0.8	49	2.1	36	2.1	53	2.5	37	1.9
South Africa	37	1.6	3	0.7	1	0.3	15	1.3	4	1.0
Thailand	77	1.5	33	2.1	21	1.8	22	2.0	20	1.7
Tunisia	67	1.3	38	1.6	9	0.8	38	2.2	10	1.0
Turkey	74	1.3	20	1.7	10	1.3	29	1.8	20	1.5
United States	93	0.7	34	1.4	26	1.4	19	1.3	29	1.1
International average of 38 nations	80	0.2	43	0.3	24	0.3	40	0.4	33	0.3

[1]Designated LSS because only Latvian-speaking schools were tested which represents 61 percent of the population.

[2]Lithuania tested the same cohort of students as other nations, but later in 1999, at the beginning of the next school year.

NOTE: Eighth grade in most nations. See appendix 2 for details.

Parentheses indicate nations not meeting international sampling and/or other guidelines. See appendix 2 for details.

The international average is the average of the national percentages of the 38 nations.

s.e. means standard error.

SOURCE: Boston College, International Study Center, Third International Mathematics and Science Study–Repeat (TIMSS–R), unpublished tabulations, 1999; Mullis et al. (2000). *TIMSS 1999 International Mathematics Report: Findings from IEA's Repeat of the Third International Mathematics and Science Study at the Eighth Grade.* Exhibits 2.3, 2.9, and 2.18. Chestnut Hill, MA: Boston College.

Table A3.7.—Percent correct on science assessment item examples with standard errors, by nation: 1999

Nation	Percentage of students responding correctly											
	Figure 11		Figure 12		Figure 13		Figure 14		Figure 15		Figure 16	
	Percent	s.e.	Percent	s.e.	Percent	s.e.	Percent	s.e.	Percent	s.e.	Percent	s.e.
Australia	53	2.0	44	2.4	48	2.8	72	1.7	66	2.5	30	2.2
Belgium-Flemish	53	1.6	45	2.2	51	3.5	70	1.6	53	2.7	23	1.5
Bulgaria	41	3.3	20	2.9	28	3.2	76	1.7	50	3.3	3	0.8
Canada	46	1.3	38	1.8	43	1.9	72	1.6	60	3.0	26	1.4
Chile	14	1.1	11	1.4	8	1.3	64	1.1	38	1.9	2	0.6
Chinese Taipei	61	1.4	55	2.2	44	2.1	91	0.7	76	1.7	24	1.3
Cyprus	21	1.3	13	2.1	27	2.3	62	1.6	31	2.4	6	0.8
Czech Republic	40	1.9	26	3.0	30	2.6	72	1.8	57	3.3	19	1.7
England	51	1.6	46	3.1	42	3.0	76	1.6	56	2.6	31	1.8
Finland	48	1.8	26	2.6	40	3.0	83	1.3	57	3.0	17	1.5
Hong Kong SAR	61	1.6	36	2.3	32	2.0	79	1.4	74	2.2	20	1.3
Hungary	44	1.8	28	2.4	38	2.5	81	1.3	70	2.8	11	1.0
Indonesia	18	0.9	19	1.8	20	2.1	47	1.5	27	2.0	5	0.7
Iran, Islamic Republic of	23	1.4	9	1.3	21	1.8	76	1.3	38	2.3	2	0.4
(Israel)	25	1.2	15	1.7	35	2.6	66	1.7	51	2.5	9	1.0
Italy	21	1.4	22	2.2	23	2.3	65	1.6	50	2.3	6	1.0
Japan	52	1.2	28	2.1	46	2.1	70	1.3	68	1.7	19	1.3
Jordan	19	1.1	12	1.4	19	1.9	78	1.2	32	2.1	5	0.8
Korea, Republic of	50	1.1	54	1.7	52	1.8	73	1.1	47	2.0	30	1.1
Latvia-LSS[1]	37	1.9	20	2.5	26	2.5	69	1.7	38	2.9	7	1.0
Lithuania[2]	38	1.7	14	2.0	38	2.8	74	1.6	51	2.9	6	1.1
Macedonia, Republic of	28	1.9	21	2.2	20	2.5	65	1.8	37	2.8	7	1.1
Malaysia	51	1.6	31	2.1	20	1.8	66	1.7	24	1.3	2	0.5
Moldova	32	1.6	8	1.4	19	2.0	47	1.9	42	2.8	4	0.6
Morocco	17	1.0	2	0.8	7	1.0	24	1.1	20	1.9	2	0.5
Netherlands	49	2.9	36	4.7	58	3.9	80	2.2	61	3.5	20	2.7
New Zealand	41	1.9	38	2.7	42	2.6	66	1.7	56	2.5	28	2.0
Philippines	16	0.9	17	2.1	4	0.9	48	1.6	33	1.8	2	0.5
Romania	26	1.9	19	2.4	22	2.8	71	1.7	48	2.8	3	0.7
Russian Federation	50	2.5	30	2.6	33	2.6	81	1.3	60	3.6	6	1.1
Singapore	44	2.4	72	2.5	49	3.2	81	1.8	69	2.2	32	2.6
Slovak Republic	43	2.2	21	2.5	50	2.9	73	1.5	45	2.9	8	1.1
Slovenia	59	2.1	23	2.1	33	3.0	70	1.6	57	3.1	8	1.1
South Africa	21	0.9	3	0.8	3	0.7	26	1.7	25	1.5	1	0.2
Thailand	26	1.3	14	1.5	28	2.2	70	1.2	49	2.4	4	0.7
Tunisia	16	0.9	13	1.3	19	1.9	44	1.3	21	1.6	2	0.5
Turkey	26	1.0	23	2.1	17	2.3	58	0.9	43	2.2	4	0.8
United States	48	1.6	35	2.1	30	1.9	66	1.4	62	1.8	21	1.3
International average of 38 nations	37	0.3	26	0.4	31	0.4	67	0.2	48	0.4	12	0.2

[1]Designated LSS because only Latvian-speaking schools were tested which represents 61 percent of the population.
[2]Lithuania tested the same cohort of students as other nations, but later in 1999, at the beginning of the next school year.
NOTE: Eighth grade in most nations. See appendix 2 for details.
Parentheses indicate nations not meeting international sampling and/or other guidelines. See appendix 2 for details.
The international average is the average of the national percentages of the 38 nations.
s.e. means standard error.
SOURCE: Boston College, International Study Center, Third International Mathematics and Science Study–Repeat (TIMSS–R), unpublished tabulations, 1999; Martin et al. (2000). *TIMSS 1999 International Science Report: Findings from IEA's Repeat of the Third International Mathematics and Science Study at the Eighth Grade.* Exhibits 2.3, 2.13, and 2.18. Chestnut Hill, MA: Boston College.

Table A3.8.—U.S. eighth-grade mathematics and science achievement with standard errors, by selected characteristics: 1999

Mathematics		
Characteristics	Average	s.e.
Sex		
Boys	505	4.8
Girls	498	3.8
Race/ethnicity		
White students	525	4.6
Black students	444	5.3
Hispanic students	457	6.3
National origin of parents		
Both U.S. born	510	3.8
Both foreign born	477	8.7
1 U.S. born, 1 foreign born	496	6.4
Mother's education		
High school or less	484	3.5
Some vocational + some college	511	3.9
Completed college	539	5.4
Father's education		
High school or less	482	4.0
Some vocational + some college	512	4.3
Completed college	543	5.6
Public/nonpublic school		
Public school students	498	4.3
Nonpubic school students	526	7.4

Science		
Characteristics	Average	s.e.
Sex		
Boys	524	5.2
Girls	505	4.6
Race/ethnicity		
White students	547	4.0
Black students	438	5.7
Hispanic students	462	7.4
National origin of parents		
Both U.S. born	527	4.1
Both foreign born	472	8.0
1 U.S. born, 1 foreign born	509	7.0
Mother's education		
High school or less	499	6.1
Some vocational + some college	525	5.3
Completed college	554	4.9
Father's education		
High school or less	495	5.9
Some vocational + some college	529	6.7
Completed college	560	4.7
Public/nonpublic school		
Public school students	510	4.9
Nonpublic school students	548	7.1

NOTE: Other factors not controlled for in these analyses.
s.e. means standard error.

SOURCE: U.S. Department of Education, National Center for Education Statistics, Third International Mathematics and Science Study–Repeat (TIMSS–R), unpublished tabulations, 1999.

Table A3.9.—Average mathematics and science achievement of eighth-grade students with standard errors, by sex, by nation: 1999

Mathematics					Science				
Nation	Girls		Boys		Nation	Girls		Boys	
	Average	s.e.	Average	s.e.		Average	s.e.	Average	s.e.
Australia	524	5.7	526	5.7	Australia	532	5.1	549	6.0
Belgium-Flemish	560	7.2	556	8.3	Belgium-Flemish	526	4.7	544	7.2
Bulgaria	510	5.9	511	6.9	Bulgaria	511	5.8	525	6.5
Canada	529	2.5	533	3.2	Canada	526	3.2	540	2.4
Chile	388	4.3	397	5.8	Chile	409	4.3	432	5.1
Chinese Taipei	583	3.9	587	5.3	Chinese Taipei	561	3.9	578	5.7
Cyprus	479	2.1	474	2.7	Cyprus	455	3.1	465	3.0
Czech Republic	512	4.0	528	5.8	Czech Republic	523	4.8	557	4.9
England	487	5.4	505	5.0	England	522	6.2	554	5.3
Finland	519	3.0	522	3.5	Finland	530	4.0	540	4.5
Hong Kong SAR	583	4.7	581	5.9	Hong Kong SAR	522	4.4	537	5.1
Hungary	529	4.0	535	4.3	Hungary	540	4.0	565	4.5
Indonesia	401	5.4	405	5.0	Indonesia	427	6.5	444	4.8
Iran, Islamic Republic of	408	4.2	432	4.8	Iran, Islamic Republic of	430	5.7	461	4.4
(Israel)	459	4.2	474	4.8	(Israel)	461	6.0	476	5.5
Italy	475	4.5	484	4.3	Italy	484	4.1	503	5.6
Japan	575	2.4	582	2.3	Japan	543	2.8	556	3.6
Jordan	431	4.7	425	5.9	Jordan	460	5.0	442	5.9
Korea, Republic of	585	3.1	590	2.2	Korea, Republic of	538	4.0	559	3.2
Latvia-LSS[1]	502	3.8	508	4.4	Latvia-LSS[1]	495	5.6	510	4.8
Lithuania[2]	480	4.7	483	4.8	Lithuania[2]	478	4.4	499	5.0
Macedonia, Republic of	446	5.3	447	4.3	Macedonia, Republic of	458	6.0	458	5.4
Malaysia	521	4.7	517	6.0	Malaysia	488	5.5	498	5.8
Moldova	468	4.1	471	4.7	Moldova	454	4.4	465	5.4
Morocco	326	5.3	344	4.1	Morocco	312	5.9	330	5.9
Netherlands	538	7.6	542	7.0	Netherlands	536	7.1	554	7.3
New Zealand	495	5.5	487	7.6	New Zealand	506	5.4	513	7.0
Philippines	352	6.9	337	6.5	Philippines	351	8.2	339	8.9
Romania	475	6.3	470	6.2	Romania	468	6.4	475	6.5
Russian Federation	526	6.0	526	6.4	Russian Federation	519	7.1	540	6.2
Singapore	603	6.1	606	7.5	Singapore	557	7.9	578	9.7
Slovak Republic	532	4.2	536	4.5	Slovak Republic	525	3.4	546	4.5
Slovenia	529	3.0	531	3.6	Slovenia	527	3.7	540	3.7
South Africa	267	7.5	283	7.3	South Africa	234	9.2	253	7.7
Thailand	469	5.7	465	5.5	Thailand	481	4.6	484	4.4
Tunisia	436	2.4	460	2.9	Tunisia	417	3.3	442	4.3
Turkey	428	4.7	429	4.4	Turkey	431	4.8	434	4.3
United States	498	3.9	505	4.8	United States	505	4.6	524	5.5
International average of 38 nations	485	0.8	489	0.9	International average of 38 nations	480	0.9	495	0.9

[1]Designated LSS because only Latvian-speaking schools were tested which represents 61 percent of the population.

[2]Lithuania tested the same cohort of students as other nations, but later in 1999, at the beginning of the next school year.

NOTE: Eighth grade in most nations. See appendix 2 for details.

Parentheses indicate nations not meeting international sampling and/or other guidelines. See appendix 2 for details.

The international average is the average of the national averages of the 38 nations.

s.e. means standard error.

SOURCE: Martin et al. (2000). *TIMSS 1999 International Science Report: Findings from IEA's Repeat of the Third International Mathematics and Science Study at the Eighth Grade.* Exhibit 1.11. Chestnut Hill, MA: Boston College; Mullis et al. (2000). *TIMSS 1999 International Mathematics Report: Findings from IEA's Repeat of the Third International Mathematics and Science Study at the Eighth Grade.* Exhibit 1.11. Chestnut Hill, MA: Boston College.

Table A3.10.—Comparisons of eighth-grade mathematics achievement with standard errors, by nation: 1995 and 1999

Nation	1995		1999		1995–1999 difference[3]	
	Average	s.e.	Average	s.e.	Average	s.e.
(Australia)	519	3.8	525	4.8	6	6.1
Belgium-Flemish	550	5.9	558	3.3	8	6.8
(Bulgaria)	527	5.8	511	5.9	-16	8.2
Canada	521	2.2	531	2.5	10	3.2
Cyprus	468	2.2	476	1.8	9	2.9
Czech Republic	546	4.5	520	4.2	-26	6.1
(England)	498	3.0	496	4.2	-1	5.2
Hong Kong SAR	569	6.1	582	4.3	13	7.5
Hungary	527	3.2	532	3.7	5	4.9
Iran, Islamic Republic of	418	3.9	422	3.4	4	5.2
Italy	491	3.4	485	4.8	-6	6.0
Japan	581	1.6	579	1.7	-2	2.2
Korea, Republic of	581	2.0	587	2.0	6	2.8
(Latvia-LSS)[1]	488	3.6	505	3.4	17	5.0
(Lithuania)[2]	472	4.1	482	4.3	10	6.1
(Netherlands)	529	6.1	540	7.1	11	9.5
New Zealand	501	4.7	491	5.2	-10	7.1
(Romania)	474	4.6	472	5.8	-1	7.4
Russian Federation	524	5.3	526	5.9	2	8.0
Singapore	609	4.0	604	6.3	-4	7.4
Slovak Republic	534	3.1	534	4.0	0	4.9
(Slovenia)	531	2.8	530	2.8	-1	3.9
United States	492	4.7	502	4.0	9	6.2
International average of 23 nations	519	0.9	521	0.9	2	1.3

Nations with unapproved sampling procedures at the classroom level in 1995

(Israel)[4]	513	6.2	482	4.7	-32	7.8
(South Africa)[4]	278	9.2	275	6.8	-3	11.5
(Thailand)[4]	516	6.1	467	5.1	-49	7.9

[1]Designated LSS because only Latvian-speaking schools were tested.

[2]Lithuania tested the same cohort of students as other nations, but later in 1999, at the beginning of the next school year.

[3]Difference is calculated by subtracting the 1995 score from the 1999 score. Detail may not sum to totals due to rounding.

[4]Israel, South Africa and Thailand experienced significant difficulties with meeting international guidelines in 1995. These nations' averages are not included in the international average.

NOTE: Eighth grade in most nations. See appendix 2 for details.

Parentheses indicate nations not meeting international sampling and/or other guidelines in 1995, 1999, or both years. See appendix 2 for details regarding 1999 data. See NCES (1996) for detatils for 1995 data.

The international average is the average of the national averages of the 23 nations.

The 1995 scores are based on re-scaled data.

s.e. means standard error.

SOURCE: Mullis et al. (2000). *TIMSS 1999 International Mathematics Report: Findings from IEA's Repeat of the Third International Mathematics and Science Study at the Eighth Grade.* Exhibit 1.3. Chestnut Hill, MA: Boston College.

Table A3.11.—Comparisons of eighth-grade science achievement with standard errors, by nation: 1995 and 1999

Nation	1995		1999		1995–1999 difference[3]	
	Average	s.e.	Average	s.e.	Average	s.e.
(Australia)	527	4.0	540	4.4	14	6.0
Belgium-Flemish	533	6.4	535	3.1	2	7.1
(Bulgaria)	545	5.2	518	5.4	-27	7.5
Canada	514	2.6	533	2.1	19	3.3
Cyprus	452	2.1	460	2.4	8	3.3
Czech Republic	555	4.5	539	4.2	-16	6.1
(England)	533	3.6	538	4.8	5	5.8
Hong Kong SAR	510	5.8	530	3.7	20	6.8
Hungary	537	3.1	552	3.7	16	4.9
Iran, Islamic Republic of	463	3.6	448	3.8	-15	5.2
Italy	497	3.6	498	4.8	1	5.9
Japan	554	1.8	550	2.2	-5	3.0
Korea, Republic of	546	2.0	549	2.6	3	3.4
(Latvia-LSS)[1]	476	3.3	503	4.8	27	5.9
(Lithuania)[2]	464	4.0	488	4.1	25	5.7
(Netherlands)	541	6.0	545	6.9	3	9.1
New Zealand	511	4.9	510	4.9	-1	6.9
(Romania)	471	5.1	472	5.8	1	7.8
Russian Federation	523	4.5	529	6.4	7	7.9
Singapore	580	5.5	568	8.0	-12	9.8
Slovak Republic	532	3.3	535	3.3	3	4.5
(Slovenia)	541	2.8	533	3.2	-8	4.4
United States	513	5.6	515	4.6	2	7.2
International average of 23 nations	518	0.9	521	0.9	3	1.3

Nations with unapproved sampling procedures at the classroom level in 1995

(Israel)[4]	509	6.3	484	5.7	-25	8.3
(South Africa)[4]	263	11.1	243	7.9	-20	13.7
(Thailand)[4]	510	4.7	482	4.0	-28	6.2

[1]Designated LSS because only Latvian-speaking schools were tested.

[2]Lithuania tested the same cohort of students as other nations, but later in 1999, at the beginning of the next school year.

[3]Difference is calculated by subtracting the 1995 score from the 1999 score. Detail may not sum to totals due to rounding.

[4]Israel, South Africa and Thailand experienced significant difficulties with meeting international guidelines in 1995. These nations' averages are not included in the international average.

NOTE: Eighth grade in most nations. See appendix 2 for details.

Parentheses indicate nations not meeting international sampling and/or other guidelines in 1995, 1999, or both years. See appendix 2 for details regarding 1999 data. See NCES (1996) for detatils for 1995 data.

The international average is the average of the national averages of the 23 nations.

The 1995 scores are based on re-scaled data.

s.e. means standard error.

SOURCE: Martin et al. (2000). *TIMSS 1999 International Science Report: Findings from IEA's Repeat of the Third International Mathematics and Science Study at the Eighth Grade.* Exhibit 1.3. Chestnut Hill, MA: Boston College.

Table A3.12.—Comparisons of percentages of eighth-grade students reaching the TIMSS–R 1999 top 10 percent international benchmark of mathematics achievement with standard errors: 1995 and 1999

Nation	1995 percentage of students		1999 percentage of students		1995–1999 difference[3]	
	Percent	s.e.	Percent	s.e.	Percent	s.e.
(Australia)	11	1.2	12	1.8	1	2.2
Belgium-Flemish	19	1.6	23	1.4	4	2.2
(Bulgaria)	19	2.0	11	2.3	-8	3.0
Canada	9	0.9	12	1.1	3	1.4
Cyprus	4	0.4	3	0.4	-1	0.6
Czech Republic	19	2.1	11	1.4	-8	2.5
(England)	8	1.2	7	0.9	0	1.6
Hong Kong SAR	28	2.6	33	2.3	5	3.4
Hungary	13	1.1	16	1.2	3	1.6
Iran, Islamic Republic of	0	0.3	1	0.2	0	0.4
Italy	7	0.8	6	1.0	-1	1.2
Japan	34	1.0	33	1.1	0	1.5
Korea, Republic of	36	1.2	37	1.0	2	1.4
(Lativa-LSS)[1]	5	0.8	7	0.9	3	1.2
(Lithuania)[2]	3	0.5	4	0.7	1	0.9
(Netherlands)	12	2.1	14	2.3	3	3.1
New Zealand	8	1.2	8	1.2	0	1.7
(Romania)	5	0.8	5	1.1	0	1.3
Russian Federation	12	1.4	15	1.8	2	2.2
Singapore	46	3.0	46	3.5	0	4.7
Slovak Republic	14	1.2	14	1.4	-1	1.8
(Slovenia)	13	1.1	15	1.2	2	1.5
United States	6	0.9	9	1.0	3	1.4
International average of 23 nations	14	0.4	15	0.3	1	0.4
Nations with unapproved sampling procedures at the classroom level in 1995						
(Israel)[4]	8	1.5	6	0.7	-3	1.6
(South Africa)[4]	0	0.2	0	0.2	0	0.3
(Thailand)[4]	10	2.1	4	0.8	-5	2.3

[1]Designated LSS because only Latvian-speaking schools were tested.

[2]Lithuania tested the same cohort of students as other nations, but later in 1999, at the beginning of the next school year.

[3]Difference is calculated by subtracting the 1995 score from the 1999 score. Detail may not sum to totals due to rounding.

[4]Israel, South Africa and Thailand experienced significant difficulties with meeting international guidelines in 1995. These nations' averages are not included in the international average.

NOTE: Eighth grade in most nations. See appendix 2 for details.

Parentheses indicate nations not meeting international sampling and/or other guidelines in 1995, 1999, or both years. See appendix 2 for details regarding 1999 data. See (NCES 1996) for details for 1995 data.

The international average is the average of the national averages of the 23 nations.

The 1995 scores are based on re-scaled data.

s.e. means standard error.

SOURCE: Martin et al. (2000). *TIMSS 1999 International Science Report: Findings from IEA's Repeat of the Third International Mathematics and Science Study at the Eighth Grade.* Exhibit 1.7. Chestnut Hill, MA: Boston College.

Table A3.13.—Comparisons of percentages of eighth-grade students reaching the TIMSS–R 1999 top 10 percent international benchmark of science achievement with standard errors: 1995 and 1999

Nation	1995 percentage of students		1999 percentage of students		1995–1999 difference[3]	
	Percent	s.e.	Percent	s.e.	Percent	s.e.
(Australia)	17	1.3	19	1.6	3	2.0
Belgium-Flemish	12	1.2	11	1.4	-1	1.8
(Bulgaria)	24	1.8	14	2.1	-10	2.8
Canada	11	0.7	14	0.9	3	1.1
Cyprus	3	0.4	2	0.5	0	0.6
Czech Republic	21	2.2	17	1.7	-4	2.6
(England)	17	1.8	19	1.9	2	2.6
Hong Kong SAR	9	1.2	10	1.1	1	1.7
Hungary	14	1.2	22	1.4	8	1.9
Iran, Islamic Republic of	2	0.5	2	0.3	0	0.6
Italy	7	1.0	8	1.1	1	1.5
Japan	21	1.0	19	1.1	-2	1.6
Korea, Republic of	20	1.0	22	1.1	2	1.6
(Lativa-LSS)[1]	4	0.7	7	1.3	3	1.4
(Lithuania)[2]	3	0.7	6	0.9	3	1.1
(Netherlands)	15	2.0	16	2.3	1	3.0
New Zealand	11	1.3	12	1.4	0	1.9
(Romania)	6	0.9	6	0.8	0	1.2
Russian Federation	13	1.2	17	2.4	4	2.8
Singapore	33	3.2	32	3.3	-1	4.6
Slovak Republic	15	1.3	14	1.4	0	1.8
(Slovenia)	16	1.2	16	1.1	0	1.7
United States	13	1.2	15	1.2	2	1.7
International average of 23 nations	13	0.3	14	0.4	1	0.4

Nations with unapproved sampling procedures at the classroom level in 1995

(Israel)[4]	12	1.8	8	0.8	-4	2.0
(South Africa)[4]	1	0.5	0	0.2	0	0.6
(Thailand)[4]	6	1.3	3	0.7	-2	1.5

[1]Designated LSS because only Latvian-speaking schools were tested.

[2]Lithuania tested the same cohort of students as other nations, but later in 1999, at the beginning of the next school year.

[3]Difference is calculated by subtracting the 1995 score from the 1999 score. Detail may not sum to totals due to rounding.

[4]Israel, South Africa and Thailand experienced significant difficulties with meeting international guidelines in 1995. These nations' averages are not included in the international average.

NOTE: Eighth grade in most nations. See appendix 2 for details.

Parentheses indicate nations not meeting international sampling and/or other guidelines in 1995, 1999, or both years. See appendix 2 for details regarding 1999 data. See NCES (1996) for details for 1995 data.

The international average is the average of the national averages of the 23 nations.

The 1995 scores are based on re-scaled data.

s.e. means standard error.

SOURCE: Martin et al. (2000). *TIMSS 1999 International Science Report: Findings from IEA's Repeat of the Third International Mathematics and Science Study at the Eighth Grade.* Exhibit 1.7. Chestnut Hill, MA: Boston College.

Table A3.14.—Comparisons of percent correct in mathematics content areas with standard errors: 1995 and 1999

Nation	Percent correct in mathematics content areas											
	Total mathematics trend items (48 items)				Fractions and number sense trend items (17 items)				Measurement trend items (6 items)			
	1995		1999		1995		1999		1995		1999	
	Percent	s.e.	Percent	s.e.	Percent	s.e.	Percent	s.e.	Percent	s.e.	Percent	s.e.
(Australia)	68	0.9	69	1.1	68	0.8	70	1.0	71	0.9	73	1.1
Belgium-Flemish	73	1.3	76	1.2	75	1.2	77	0.8	77	1.5	79	1.7
(Bulgaria)	70	1.3	65	1.3	67	1.6	61	1.4	69	1.5	63	1.1
Canada	67	0.5	70	0.4	69	0.5	72	0.5	64	0.6	67	0.7
Cyprus	54	0.5	56	0.4	55	0.5	58	0.5	45	0.8	46	0.6
Czech Republic	72	1.0	67	0.9	67	1.2	61	1.1	80	0.8	77	1.0
(England)	64	0.6	63	0.9	65	0.7	65	0.9	67	0.8	66	1.2
Hong Kong SAR	77	1.3	79	0.9	78	1.3	81	0.9	76	1.4	77	1.0
Hungary	67	0.8	68	0.8	63	0.8	65	0.9	73	0.8	74	0.7
Iran, Islamic Republic of	44	0.6	44	0.6	46	0.7	45	0.7	31	1.0	34	0.7
Italy	60	0.9	58	1.1	57	1.0	55	1.1	64	1.2	63	1.2
Japan	78	0.3	78	0.3	76	0.4	76	0.4	75	0.4	74	0.5
Korea, Republic of	80	0.4	81	0.4	76	0.5	77	0.4	81	0.6	83	0.4
(Latvia-LSS)[1]	59	0.8	64	0.8	54	0.9	59	0.9	66	1.0	70	1.0
(Lithuania)[2]	56	1.0	57	1.0	52	1.0	54	1.1	57	0.9	56	0.9
(Netherlands)	70	1.6	74	1.6	70	1.3	75	1.7	76	1.6	77	1.6
New Zealand	64	1.1	62	1.2	65	1.0	63	1.2	66	1.2	65	1.3
(Romania)	55	1.0	54	1.1	51	0.9	50	1.1	57	1.2	57	1.3
Russian Federation	68	1.4	68	1.3	64	1.7	64	1.4	69	1.1	73	1.3
Singapore	84	0.7	83	1.1	87	0.6	85	1.0	86	0.7	83	1.1
Slovak Republic	69	0.7	69	0.9	66	0.8	67	1.1	75	0.7	75	0.9
(Slovenia)	69	0.7	70	0.6	68	0.8	69	0.7	72	0.8	72	0.7
United States	61	1.1	63	0.9	63	1.1	66	0.9	53	1.1	55	1.1
International average of 23 nations	65	0.2	65	0.2	64	0.2	64	0.2	66	0.2	66	0.2
Nations with unapproved sampling procedures at the classroom level in 1995												
(Israel)[3]	66	1.3	59	1.1	67	1.2	61	1.0	63	1.5	55	1.1
(South Africa)[3]	29	1.2	27	0.8	32	1.2	29	0.8	30	1.4	28	0.7
(Thailand)[3]	65	1.3	54	1.0	66	1.3	55	1.1	63	1.5	51	1.2

[1]Designated LSS because only Latvian-speaking schools were tested.

[2]Lithuania tested the same cohort of students as other nations, but later in 1999, at the beginning of the next school year.

[3]Israel, South Africa and Thailand experienced significant difficulties with meeting international guidelines in 1995. These nations' averages are not included in the international average.

NOTE: Eighth grade in most nations. See appendix 2 for details.

Parentheses indicate nations not meeting international sampling and/or other guidelines in 1995, 1999, or both years. See appendix 2 for details regarding 1999 data. See NCES (1996) for details for 1995 data.

The international average is the average of the national averages of the 23 nations.

The 1995 scores are based on re-scaled data.

s.e. means standard error.

SOURCE: Mullis et al. (2000). *TIMSS 1999 International Mathematics Report: Findings from IEA's Repeat of the Third International Mathematics and Science Study at the Eighth Grade.* Exhibit 3.4. Chestnut Hill, MA: Boston College.

Table A3.14.—Comparisons of percent correct in mathematics content areas with standard errors: 1995 and 1999—Continued

Nation	Percent correct in mathematics content areas											
	Data represenation, analysis, and probability trend items (8 items)				Geometry trend items (6 items)				Algebra trend items (11 items)			
	1995		1999		1995		1999		1995		1999	
	Percent	s.e.	Percent	s.e.	Percent	s.e.	Percent	s.e.	Percent	s.e.	Percent	s.e.
(Australia)	71	0.8	74	1.0	58	1.1	59	1.4	67	1.0	69	1.2
Belgium-Flemish	74	1.3	77	1.3	66	1.4	69	1.9	72	1.6	73	1.3
(Bulgaria)	74	1.3	66	1.1	76	1.2	73	1.5	71	1.5	66	1.4
Canada	70	0.7	73	0.5	61	0.7	64	0.7	64	0.7	70	0.6
Cyprus	56	0.7	59	0.6	56	0.8	59	0.7	53	0.6	54	0.6
Czech Republic	75	0.8	73	0.8	73	1.2	67	1.2	72	1.3	65	1.1
(England)	71	0.7	73	0.9	51	1.0	49	1.2	61	0.8	60	1.2
Hong Kong SAR	74	1.1	78	0.8	78	1.6	80	1.1	78	1.4	79	1.0
Hungary	74	0.6	75	0.9	56	1.1	55	1.1	70	0.9	72	0.8
Iran, Islamic Republic of	45	0.7	47	0.6	44	0.9	44	0.8	48	0.9	47	0.8
Italy	67	0.9	65	1.3	59	1.2	58	1.3	58	1.0	55	1.3
Japan	79	0.3	80	0.4	84	0.4	82	0.5	79	0.4	79	0.5
Korea, Republic of	85	0.5	85	0.3	83	0.6	84	0.5	81	0.4	83	0.5
(Latvia-LSS)[1]	63	0.9	69	0.8	67	1.0	73	0.9	56	1.0	60	0.9
(Lithuania)[2]	61	1.0	66	0.9	64	1.3	63	1.4	55	1.2	54	1.2
(Netherlands)	77	1.6	80	1.5	62	1.8	66	1.7	65	2.1	70	2.0
New Zealand	70	1.0	69	1.3	55	1.3	51	1.4	60	1.2	60	1.5
(Romania)	57	1.1	56	1.1	62	1.3	59	1.3	56	1.2	55	1.3
Russian Federation	69	1.4	69	1.2	71	1.0	70	1.6	69	1.5	71	1.4
Singapore	79	0.8	79	1.1	82	0.9	81	1.3	83	0.9	82	1.3
Slovak Republic	71	0.8	73	0.9	71	0.9	71	1.2	67	1.0	66	1.1
(Slovenia)	75	0.7	76	0.7	64	0.9	63	0.9	69	0.8	69	0.7
United States	67	1.0	69	0.9	50	1.1	52	1.0	63	1.3	66	1.0
International average of 23 nations	68	0.2	69	0.2	63	0.2	63	0.2	64	0.2	65	0.2
Nations with unapproved sampling procedures at the classroom level in 1995												
(Israel)[3]	66	1.5	62	1.1	65	1.6	56	1.3	65	1.6	59	1.2
(South Africa)[3]	31	1.1	29	0.8	23	1.2	22	0.7	27	1.4	26	1.0
(Thailand)[3]	66	1.0	58	1.0	68	1.4	57	1.3	64	1.5	50	1.1

[1]Designated LSS because only Latvian-speaking schools were tested.

[2]Lithuania tested the same cohort of students as other nations, but later in 1999, at the beginning of the next school year.

[3]Israel, South Africa and Thailand experienced significant difficulties with meeting international guidelines in 1995. These nations' averages are not included in the international average.

NOTE: Eighth grade in most nations. See appendix 2 for details.

Parentheses indicate nations not meeting international sampling and/or other guidelines in 1995, 1999, or both years. See appendix 2 for details regarding 1999 data. See NCES (1996) for details for 1995 data.

The international average is the average of the national averages of the 23 nations.

The 1995 scores are based on re-scaled data.

s.e. means standard error.

SOURCE: Mullis et al. (2000). *TIMSS 1999 International Mathematics Report: Findings from IEA's Repeat of the Third International Mathematics and Science Study at the Eighth Grade.* Exhibit 3.4. Chestnut Hill, MA: Boston College.

Table A3.15.—Comparisons of percent correct in science content areas with standard errors: 1995 and 1999

Nation	Percent correct in science content areas											
	Total science trend items (48 items)				Earth science trend items (11 items)				Life science items (13 items)			
	1995		1999		1995		1999		1995		1999	
	Percent	s.e.	Percent	s.e.	Percent	s.e.	Percent	s.e.	Percent	s.e.	Percent	s.e.
(Australia)	68	0.6	69	0.7	64	0.7	64	0.9	75	0.6	76	0.7
Belgium-Flemish	69	0.8	69	0.5	68	0.8	67	0.7	76	1.0	77	0.7
(Bulgaria)	74	0.9	72	0.8	70	1.1	68	1.0	82	0.8	80	0.8
Canada	65	0.4	68	0.3	61	0.6	64	0.5	72	0.5	75	0.4
Cyprus	56	0.4	57	0.3	53	0.5	53	0.4	67	0.6	67	0.5
Czech Republic	74	0.7	72	0.6	73	0.9	69	0.8	84	0.7	83	0.6
(England)	68	0.5	70	0.6	63	0.7	65	0.7	75	0.6	77	0.7
Hong Kong SAR	66	0.8	69	0.5	60	0.8	63	0.5	77	0.9	79	0.6
Hungary	73	0.5	76	0.5	74	0.7	76	0.7	81	0.6	82	0.5
Iran, Islamic Republic of	59	0.5	57	0.7	57	0.6	55	0.7	62	0.6	60	0.6
Italy	65	0.7	64	0.8	62	0.9	62	1.0	72	0.8	72	0.8
Japan	71	0.3	72	0.3	65	0.4	68	0.4	77	0.4	78	0.4
Korea, Republic of	71	0.4	72	0.3	70	0.5	71	0.4	76	0.5	76	0.4
(Latvia-LSS)[1]	63	0.5	65	0.5	61	0.8	64	0.8	71	0.7	75	0.6
(Lithuania)[2]	62	0.7	65	0.7	58	0.9	60	0.8	68	0.8	71	0.7
(Netherlands)	71	1.0	71	1.1	65	1.4	68	1.3	81	1.0	81	1.3
New Zealand	64	0.7	63	0.7	59	0.8	59	0.8	70	0.9	70	0.9
(Romania)	62	0.9	62	0.8	61	1.0	60	1.0	69	1.0	68	0.8
Russian Federation	69	0.8	72	1.1	65	0.7	67	1.2	75	0.8	77	1.1
Singapore	74	0.9	71	1.2	64	1.0	61	1.0	80	0.9	78	1.3
Slovak Republic	70	0.6	71	0.6	67	0.8	67	0.8	76	0.6	84	0.6
(Slovenia)	72	0.5	70	0.5	76	0.6	73	0.6	76	0.5	76	0.6
United States	66	0.7	67	0.6	62	0.8	62	0.7	75	0.8	76	0.8
International average of 23 nations	66	0.1	67	0.1	63	0.2	63	0.2	73	0.2	74	0.2

Nations with unapproved sampling procedures at the classroom level in 1995

(Israel)[3]	67	0.9	63	0.8	61	1.0	57	0.9	74	1.1	68	0.9
(South Africa)[3]	37	1.1	35	0.7	34	1.0	34	0.5	38	1.4	37	0.9
(Thailand)[3]	65	0.8	58	0.8	63	0.9	52	0.9	79	0.7	72	0.8

[1]Designated LSS because only Latvian-speaking schools were tested.

[2]Lithuania tested the same cohort of students as other nations, but later in 1999, at the beginning of the next school year.

[3]Israel, South Africa and Thailand experienced significant difficulties with meeting international guidelines in 1995. These nations' averages are not included in the international average.

NOTE: Eighth grade in most nations. See appendix 2 for details.

Parentheses indicate nations not meeting international sampling and/or other guidelines in 1995, 1999, or both years. See appendix 2 for details regarding 1999 data. See NCES (1996) for details for 1995 data.

The international average is the average of the national averages of the 23 nations.

The 1995 scores are based on re-scaled data.

s.e. means standard error.

SOURCE: Martin et al. (2000). *TIMSS 1999 International Science Report: Findings from IEA's Repeat of the Third International Mathematics and Science Study at the Eighth Grade.* Exhibit 3.4. Chestnut Hill, MA: Boston College.

Table A3.15.—Comparisons of percent correct in science content areas with standard errors: 1995 and 1999—Continued

Nation	Percent correct in science content areas							
	Physics trend items (15 items)				Chemistry trend items (5 items)			
	1995		1999		1995		1999	
	Percent	s.e.	Percent	s.e.	Percent	s.e.	Percent	s.e.
(Australia)	62	0.6	64	0.7	71	0.9	72	1.0
Belgium-Flemish	64	0.9	63	0.5	72	0.8	70	0.8
(Bulgaria)	69	1.1	67	0.9	80	1.4	76	1.1
Canada	61	0.5	64	0.4	71	0.6	74	0.6
Cyprus	50	0.4	53	0.4	62	0.7	61	0.6
Czech Republic	68	0.6	65	0.7	72	1.0	70	0.9
(England)	65	0.6	65	0.7	72	1.0	73	0.9
Hong Kong SAR	62	0.8	64	0.5	68	1.3	72	0.9
Hungary	63	0.5	69	0.6	78	0.8	83	0.6
Iran, Islamic Republic of	56	0.7	54	0.8	66	0.7	64	0.9
Italy	59	0.7	58	0.9	68	1.1	66	1.2
Japan	69	0.3	69	0.3	74	0.6	74	0.6
Korea, Republic of	68	0.4	69	0.4	72	0.7	73	0.5
(Latvia-LSS)[1]	56	0.6	57	0.6	62	0.8	68	0.8
(Lithuania)[2]	58	0.7	61	0.7	68	1.0	70	1.2
(Netherlands)	66	0.8	66	1.0	72	1.2	73	1.2
New Zealand	59	0.6	58	0.6	70	1.1	68	1.0
(Romania)	57	1.0	57	0.9	65	1.1	65	1.2
Russian Federation	66	1.1	68	1.3	74	1.4	77	1.3
Singapore	74	0.8	72	1.0	81	1.1	76	1.6
Slovak Republic	65	0.7	62	0.7	77	0.8	74	1.0
(Slovenia)	65	0.6	63	0.5	72	1.0	71	0.8
United States	61	0.6	62	0.6	72	1.2	72	1.0
International average of 23 nations	62	0.1	62	0.1	70	0.2	70	0.2
Nations with unapproved sampling procedures at the classroom level in 1995								
(Israel)[3]	62	0.9	62	0.7	73	1.3	69	1.2
(South Africa)[3]	37	1.2	34	0.7	38	1.3	35	1.0
(Thailand)[3]	59	0.9	53	0.8	50	1.1	45	1.0

[1]Designated LSS because only Latvian-speaking schools were tested.

[2]Lithuania tested the same cohort of students as other nations, but later in 1999, at the beginning of the next school year.

[3]Israel, South Africa and Thailand experienced significant difficulties with meeting international guidelines in 1995. These nations' averages are not included in the international average.

NOTE: Eighth grade in most nations. See appendix 2 for details.

Parentheses indicate nations not meeting international sampling and/or other guidelines in 1995, 1999, or both years. See appendix 2 for details regarding 1999 data. See NCES (1996) for details for 1995 data.

The international average is the average of the national averages of the 23 nations.

The 1995 scores are based on re-scaled data.

s.e. means standard error.

SOURCE: Martin et al. (2000). *TIMSS 1999 International Science Report: Findings from IEA's Repeat of the Third International Mathematics and Science Study at the Eighth Grade.* Exhibit 3.4. Chestnut Hill, MA: Boston College.

Table A3.16.—U.S. mathematics and science achievement with standard errors, by selected characteristics: 1995 and 1999

MATHEMATICS					
1995			1999		
Characteristics	Average	s.e.	Characteristics	Average	s.e.
Sex			**Sex**		
Boys	495	5.5	Boys	505	4.8
Girls	490	4.7	Girls	498	3.9
Race/ethnicity			Race/ethnicity		
White students	516	3.5	White students	525	4.6
Black students	419	6.8	Black students	444	5.3
Hispanic students	443	3.8	Hispanic students	457	6.3
National origin of parents			National origin of parents		
Both U.S. born	496	4.5	Both U.S. born	510	3.8
Both foreign born	474	8.5	Both foreign born	477	8.7
1 U.S. born, 1 foreign born	482	11.1	1 U.S. born, 1 foreign born	496	6.4
Mother's education			Mother's education		
High school or less	479	4.2	High school or less	484	3.5
Some vocational+some college	498	5.2	Some vocational+some college	511	3.9
Completed college	511	6.3	Completed college	539	5.4
Father's education			Father's education		
High school or less	474	4.4	High school or less	482	4.0
Some vocational+some college	498	4.7	Some vocational+some college	512	4.2
Completed college	515	5.7	Completed college	543	5.6

SCIENCE					
Sex			**Sex**		
Boys	520	5.9	Boys	524	5.5
Girls	505	5.5	Girls	505	4.6
Race/ethnicity			Race/ethnicity		
White students	544	3.3	White students	547	4.0
Black students	422	8.3	Black students	438	5.7
Hispanic students	446	5.0	Hispanic students	462	7.4
National origin of parents			National origin of parents		
Both U.S. born	521	4.9	Both U.S. born	527	4.1
Both foreign born	465	8.9	Both foreign born	472	8.0
1 U.S. born, 1 foreign born	498	11.5	1 U.S. born, 1 foreign born	509	7.0
Mother's education			Mother's education		
High school or less	497	4.8	High school or less	499	6.1
Some vocational+some college	522	6.2	Some vocational+some college	525	5.3
Completed college	531	6.5	Completed college	554	4.9
Father's education			Father's education		
High school or less	494	5.0	High school or less	495	5.9
Some vocational+some college	521	5.4	Some vocational+some college	529	6.7
Completed college	534	6.0	Completed college	560	4.7

NOTE: Other factors not controlled for in these analyses.
s.e. means standard error.

SOURCE: U.S. Department of Education, National Center for Education Statistics, Third International Mathematics and Science Study–Repeat (TIMSS–R), unpublished tabulations, 1999.

Table A3.17.—Mathematics achievement of TIMSS–R 1999 nations that participated in 1995 at both the fourth and eighth grades relative to the average across these nations with standard errors

1995			1999		
Fourth grade			Eighth grade		
Nation	Difference[2]	s.e.	Nation	Difference[2]	s.e.
(Australia)	0	3.0	Australia	1	4.7
Canada	-12	3.3	Canada	7	2.7
Cyprus	-42	3.1	Cyprus	-48	1.9
Czech Republic	23	3.1	Czech Republic	-4	4.1
(England)	-33	3.3	England	-28	4.0
Hong Kong SAR	40	3.8	Hong Kong SAR	58	4.2
(Hungary)	4	3.5	Hungary	8	3.6
Iran, Islamic Republic of	-130	4.8	Iran, Islamic Republic of	-102	3.3
(Italy)	-7	4.5	Italy	-39	4.6
Japan	50	2.0	Japan	55	1.8
Korea, Republic of	63	1.9	Korea, Republic of	63	2.0
(Latvia-LSS)[1]	-18	4.4	Latvia-LSS[1]	-19	3.3
(Netherlands)	32	2.9	Netherlands	16	6.8
New Zealand	-48	4.2	New Zealand	-33	4.9
Singapore	73	4.3	Singapore	80	5.9
(Slovenia)	8	3.1	Slovenia	6	2.8
United States	0	2.9	United States	-22	3.8
International average of 17 nations	517	0.9	International average of 17 nations	524	1.0

[1]Designated LSS because only Latvian-speaking schools were tested.

[2]The difference between the national average and the international average for each of the 17 nations.

NOTE: Fourth and eighth grade in most nations. See appendix 2 for details.

Parentheses indicate nations not meeting international sampling and/or other guidelines at fourth grade in 1995. See NCES (1997c) for details.

The international average is the average of the national averages of the 17 nations.

s.e. means standard error.

SOURCE: Mullis et al. (2000). *TIMSS 1999 International Mathematics Report: Findings from IEA's Repeat of the Third International Mathematics and Science Study at the Eighth Grade.* Exhibit 1.4. Chestnut Hill, MA: Boston College.

Table A3.18.—Science achievement of TIMSS–R 1999 nations that participated in 1995 at both the fourth and eighth grades relative to the average across these nations with standard errors

1995			1999		
Fourth grade			Eighth grade		
Nation	Difference[2]	s.e.	Nation	Difference[2]	s.e.
(Australia)	28	3.5	Australia	16	4.3
Canada	12	3.0	Canada	9	2.1
Cyprus	-64	3.1	Cyprus	-64	2.3
Czech Republic	18	3.0	Czech Republic	15	4.1
(England)	14	3.1	England	14	4.5
Hong Kong SAR	-6	3.3	Hong Kong SAR	5	3.5
(Hungary)	-6	3.3	Hungary	28	3.6
Iran, Islamic Republic of	-134	4.4	Iran, Islamic Republic of	-76	3.7
(Italy)	10	4.4	Italy	-26	4.5
Japan	39	1.9	Japan	25	2.4
Korea, Republic of	62	2.2	Korea, Republic of	24	2.6
(Latvia-LSS)[1]	-27	4.7	Latvia-LSS[1]	-21	4.9
(Netherlands)	17	3.1	Netherlands	21	6.5
New Zealand	-9	5.1	New Zealand	-15	4.8
Singapore	10	4.6	Singapore	44	7.6
(Slovenia)	8	3.9	Slovenia	9	3.3
United States	28	3.2	United States	-9	4.5
International average of 17 nations	514	0.9	International average of 17 nations	524	1.1

[1]Designated LSS because only Latvian-speaking schools were tested.

[2]The difference between the national average and the international average for each of the 17 nations.

NOTE: Fourth and eighth grade in most nations. See appendix 2 for details.

Parentheses indicate nations not meeting international sampling and/or other guidelines at fourth grade in 1995. See NCES (1997c) for details.

The international average is the average of the national averages of the 17 nations.

s.e. means standard error.

SOURCE: Martin et al. (2000). *TIMSS 1999 International Science Report: Findings from IEA's Repeat of the Third International Mathematics and Science Study at the Eighth Grade.* Exhibit 1.4. Chestnut Hill, MA: Boston College.

Appendix 4

Supporting Data for Chapter 3

Table A4.1.—Organization of science instruction at grade 8, by nation: 1999

Nations teaching science as a single general/integrated subject	Nations teaching science as separate subjects
Australia	Belgium-Flemish
Canada	Bulgaria
Chile	Chinese Taipei[1]
Cyprus	Czech Republic
England	Finland
Hong Kong SAR	Hungary
Iran, Islamic Republic of	Indonesia[2]
Israel	Latvia
Italy	Lithuania[3]
Japan	Macedonia, Republic of
Jordan	Moldova
Korea, Republic of	Morocco
Malaysia	Netherlands
New Zealand	Romania
Philippines	Russian Federation
Singapore	Slovak Republic
South Africa	Slovenia
Thailand	
Tunisia	
Turkey	
United States	

[1]In Chinese Taipei, separate sciences are taught starting in grade 7, with biology in grade 7 and physics/chemistry in grade 8. Students were administered the general version of the questionnaire and asked about "natural science." Science analyses based on teacher background data treat Chinese Taipei as teaching separate science subjects; science analyses based on student background data treat Chinese Taipei as teaching general/integrated science.

[2]In Indonesia, students are taught "IPA science" by separate biology and physics teachers, but students receive a single composite grade. Students were administered the general version of the questionnaire and asked about "IPA science." Science analyses based on teacher background data treat Indonesia as teaching separate science subjects; science analyses based on student background data treat Indonesia as teaching general/integrated science.

[3]Lithuania tested the same cohort of students as other nations, but later in 1999, at the beginning of the next school year.

NOTE: Eighth grade in most nations. See appendix 2 for details.

SOURCE: Martin et al. (2000). *TIMSS 1999 International Science Report: Findings from IEA's Repeat of the Third International Mathematics and Science Study at the Eighth Grade.* Exhibit 5. Chestnut Hill, MA: Boston College.

Table A4.2.—Eighth-grade mathematics teachers' reports of their main area of study with standard errors: 1999

Area of study	Percentage of students whose mathematics teachers reported a major area of study			
	U.S. average		International average*	
	Percent	s.e.	Percent	s.e.
Mathematics	41	3.4	71	0.6
Mathematics education	37	3.4	31	0.6
Science/science education	16	2.4	35	0.6
Education	54	3.4	32	0.6
Other	46	3.6	32	0.6

*The item response rate for this question was less than 70 percent in some nations. See Mullis et al. (2000) for details.

NOTE: Eighth grade in most nations. See appendix 2 for details.

Science includes biology, physics, chemistry, and science education.

Based on mathematics teachers' reports of major or main area of study for bachelor's and/or master's degree; more than one category could be selected.

The international average is the average of the national averages of the nations that reported data.

s.e. means standard error.

SOURCE: Mullis et al. (2000). *TIMSS 1999 International Mathematics Report: Findings from IEA's Repeat of the Third International Mathematics and Science Study at the Eighth Grade.* Exhibit R3.1. Chestnut Hill, MA: Boston College.

Table A4.3.—Eighth-grade science teachers' reports of their main area of study with standard errors: 1999

Area of study	Percentage of students whose science teachers reported a major area of study			
	U.S. average		International average*	
	Percent	s.e.	Percent	s.e.
Biology	47	3.5	42	0.8
Physics	13	2.2	23	0.7
Chemistry	21	3.0	30	0.8
Science education	43	3.7	44	0.9
Mathematics/mathematics education	14	2.5	25	0.7
Education	56	3.6	30	0.7
Other	45	3.7	29	0.8

*The item response rate for this question was less than 70 percent in some nations. See Martin et al. (2000) for details.

NOTE: Eighth grade in most nations. See appendix 2 for details.

Based on science teachers' reports of major or main area of study for bachelor's and/or master's degree; more than one category could be selected.

The international average is the average of the national averages of the nations that reported data.

s.e. means standard error.

SOURCE: Martin et al. (2000). *TIMSS 1999 International Science Report: Findings from IEA's Repeat of the Third International Mathematics and Science Study at the Eighth Grade.* Exhibit R3.1. Chestnut Hill, MA: Boston College.

Table A4.4.—Teachers' beliefs about their preparation to teach mathematics and science with standard errors: 1999

Percentage of 8th-grade students whose mathematics teachers reported feeling very well prepared to teach mathematics			Percentage of 8th-grade students whose science teachers reported feeling very well prepared to teach science		
Nation	Percent	s.e.	Nation	Percent	s.e.
Australia	84	2.7	Australia	55	1.8
Belgium-Flemish	80	1.4	Belgium-Flemish	47	2.1
Bulgaria	66	4.8	Bulgaria	46	1.9
Canada	79	1.7	Canada	44	1.7
Chile	44	2.8	Chile	29	1.9
Chinese Taipei	78	2.6	Chinese Taipei	42	2.6
Cyprus	89	0.9	Cyprus	57	1.4
Czech Republic	88	1.8	Czech Republic	64	2.0
England	—	—	England	—	—
Finland	81	1.9	Finland	47	1.7
Hong Kong SAR	72	2.6	Hong Kong SAR	34	2.4
Hungary	59	3.3	Hungary	29	1.4
Indonesia	81	2.1	Indonesia	58	2.7
Iran, Islamic Republic of	81	1.8	Iran, Islamic Republic of	42	2.8
(Israel)	84	1.6	(Israel)	55	1.7
Italy	69	2.3	Italy	42	2.1
Japan	23	2.6	Japan	17	1.7
Jordan	88	1.7	Jordan	57	2.6
Korea, Republic of	61	2.5	Korea, Republic of	31	1.9
Lativa-LSS*	73	2.1	Lativa-LSS*	37	1.5
Lithuania	—	—	Lithuania	—	—
Macedonia, Republic of	92	1.0	Macedonia, Republic of	72	1.3
Malaysia	81	2.5	Malaysia	22	2.3
Moldova	64	3.2	Moldova	39	1.6
Morocco	75	1.3	Morocco	57	1.4
Netherlands	84	5.3	Netherlands	50	1.7
New Zealand	88	1.9	New Zealand	59	2.1
Philippines	64	2.3	Philippines	41	2.3
Romania	85	1.3	Romania	57	1.5
Russian Federation	—	—	Russian Federation	—	—
Singapore	78	2.7	Singapore	46	2.4
Slovak Republic	89	1.5	Slovak Republic	—	—
Slovenia	50	2.9	Slovenia	—	—
South Africa	71	1.9	South Africa	53	2.8
Thailand	32	3.0	Thailand	30	2.4
Tunisia	51	2.6	Tunisia	32	1.9
Turkey	83	1.6	Turkey	63	2.2
United States	90	1.2	United States	58	1.5
International average of 35 nations	73	0.4	International average of 33 nations	46	0.4

*Designated LSS because only Latvian-speaking schools were tested which represents 61 percent of the population.
— Data not available.

NOTE: Eighth grade in most nations. See appendix 2 for details.
Parentheses indicate nations not meeting international sampling and/or other guidelines. See appendix 2 for details.
The international average is the average of the national averages of the nations that reported data.
s.e. means standard error.

SOURCE: Martin et al. (2000). *TIMSS 1999 International Science Report: Findings from IEA's Repeat of the Third International Mathematics and Science Study at the Eighth Grade.* Exhibit R3.2. Chestnut Hill, MA: Boston College; Mullis et al. (2000). *TIMSS 1999 International Mathematics Report: Findings from IEA's Repeat of the Third International Mathematics and Science Study at the Eighth Grade.* Exhibit R3.2. Chestnut Hill, MA: Boston College.

Table A4.5.—Percentage of U.S. eighth-grade students taught by teachers that participated in professional development activities that emphasized different topics with standard errors: 1999

Professional Development Topic	Percentage of U.S. 8th-grade students taught by teachers who said their professional development activities emphasized the topic "quite a lot" or "a great deal"			
	Mathematics		Science	
	Percent	s.e.	Percent	s.e.
Curriculum	64	3.2	59	3.7
Subject-specific teaching methods in mathematics or science	40	3.9	40	3.5
General teaching methods	38	3.4	44	3.9
Approaches to assessment	33	3.1	37	3.9
Use of technology in instruction	44	3.7	46	2.6
Strategies for teaching diverse student populations	21	3.0	23	2.5
Information on how students learn mathematics or science	21	2.8	23	4.3
Deepening teacher's knowledge of mathematics or science	28	3.4	50	2.4
Leadership development	16	2.6	19	2.4

NOTE: s.e. means standard error.
SOURCE: U.S. Department of Education, National Center for Education Statistics, Third International Mathematics and Science Study–Repeat (TIMSS–R), unpublished tabulations, 1999.

Table A4.6.—Percentage of eighth-grade students "taught" mathematics content areas with standard errors: 1999

	Fractions and number sense		Measurement		Data representation, analysis, and probability		Geometry		Algebra	
	Percent	s.e.	Percent	s.e.	Percent	s.e.	Percent	s.e.	Percent	s.e.
United States	99	0.7	91	1.6	92	1.7	65	2.9	98	0.9
International average	95	0.3	86	0.5	59	0.7	58	0.7	88	0.5

NOTE: "Taught" equals the sum of percentages of students whose mathematics teachers reported these topics as either "taught before this year" or "taught more than five periods this year."
Eighth grade in most nations. See appendix 2 for details.
The international average is the average of the national averages of the nations that reported data.
s.e. means standard error.
SOURCE: U.S. Department of Education, National Center for Education Statistics, Third International Mathematics and Science Study–Repeat (TIMSS–R), unpublished tabulations, 1999.

Table A4.7.—Percentage of eighth-grade students "taught" science content areas with standard errors: 1999

	Earth science		Biology		Physics		Chemistry		Environmental and resource issues		Scientific inquiry and the nature of science	
	Percent	s.e.	Percent	s.e.	Percent	s.e.	Percent	s.e.	Percent	s.e.	Percent	s.e.
United States	78	3.1	81	3.2	70	3.6	73	3.6	78	2.6	95	1.7
International average	57	0.7	60	0.7	53	0.7	67	0.6	72	0.6	80	0.6

NOTE: "Taught" equals the sum of percentages of students whose science teachers reported these topics as either "taught before this year" or "taught more than five periods this year."
Eighth grade in most nations. See appendix 2 for details.
The international average is the average of the national averages of the nations that reported data.
s.e. means standard error.
SOURCE: U.S. Department of Education, National Center for Education Statistics, Third International Mathematics and Science Study–Repeat (TIMSS–R), unpublished tabulations, 1999.

Table A4.8.—Eighth-grade students' reports of the occurrence of selected activities in their mathematics class "almost always" or "pretty often" with standard errors: 1999

	Teacher shows how to do a mathematics problem		Students work on worksheets or from textbooks		Students work on mathematics projects	
	Percent	s.e.	Percent	s.e.	Percent	s.e.
United States	94	0.6	86	0.7	29	1.3
International average	86	0.2	59	0.2	36	0.2

NOTE: Eighth grade in most nations. See appendix 2 for details.
The international average is the average of the national averages of the nations that reported data.
s.e. means standard error.
SOURCE: Mullis et al. (2000). *TIMSS 1999 International Mathematics Report: Findings from IEA's Repeat of the Third International Mathematics and Science Study at the Eighth Grade.* Exhibit 6.11. Chestnut Hill, MA: Boston College.

Table A4.9.—Eighth-grade students' reports of the occurrence of selected activities in their science class "almost always" or "pretty often" with standard errors: 1999

	Teacher show how to do a science problem		Students work on worksheets or from textbooks		Students work on science projects		Teacher demonstrates a science experiment		Students conduct experiments	
	Percent	s.e.	Percent	s.e.	Percent	s.e.	Percent	s.e.	Percent	s.e.
United States	69	1.4	76	1.5	59	1.3	71	1.1	65	1.5
International average of 23 nations	80	0.2	56	0.3	51	0.3	71	0.3	57	0.3

NOTE: Eighth grade in most nations. See appendix 2 for details.
The international average is the average of the national averages of the 23 nations that reported teaching a general/integrated science curriculum in 1999.
s.e. means standard error.
SOURCE: Martin et al. (2000). *TIMSS 1999 International Science Report: Findings from IEA's Repeat of the Third International Mathematics and Science Study at the Eighth Grade.* Exhibits 6.10, R3.11, and R3.13. Chestnut Hill, MA: Boston College.

Table A4.10.—Eighth-grade students' reports of access to computers and the Internet with standard errors: 1999

	Have computer at home		Have Internet access at home		Have Internet access at school		Have Internet access elsewhere	
	Percent	s.e.	Percent	s.e.	Percent	s.e.	Percent	s.e.
United States	80	1.2	59	1.7	76	3.2	81	0.9
International average	45	0.2	18	0.2	25	0.3	43	0.2

NOTE: Eighth grade in most nations. See appendix 2 for details.
The interational average is the average of the national averages of the nations that reported data.
s.e. means standard error.
SOURCE: Martin et al. (2000). *TIMSS 1999 International Science Report: Findings from IEA's Repeat of the Third International Mathematics and Science Study at the Eighth Grade.* Exhibits R1.1 and 6.17. Chestnut Hill, MA: Boston College.

Table A4.11.—Eighth-grade students' reports of using computers in mathematics and science classes "almost always" or "pretty often" with standard errors: 1999

	Mathematics		Science	
	Percent	s.e.	Percent	s.e.
United States	12	1.1	21	1.4
International average	5	0.1	8	0.2

NOTE: Eighth grade in most nations. See appendix 2 for details.
The interational average is the average of the national averages of the nations that reported data.
s.e. means standard error.

SOURCE: Martin et al. (2000). *TIMSS 1999 International Science Report: Findings from IEA's Repeat of the Third International Mathematics and Science Study at the Eighth Grade.* Exhibit 6.15. Chestnut Hill, MA: Boston College; Mullis et al. (2000). *TIMSS 1999 International Mathematics Report: Findings from IEA's Repeat of the Third International Mathematics and Science Study at the Eighth Grade.* Exhibit 6.18. Chestnut Hill, MA: Boston College.

Table A4.12.—Eighth-grade students' reports of discussing or beginning homework in mathematics and science classes "almost always" or "pretty often" with standard errors: 1999

	Discuss completed homework in mathematics class		Begin homework in mathematics class		Discuss completed homework in science class		Begin homework in science class	
	Percent	s.e.	Percent	s.e.	Percent	s.e.	Percent	s.e.
United States	79	1.2	74	1.6	63	1.9	57	2.0
International average	55	0.2	42	0.2	51	0.3	41	0.3

NOTE: Eighth grade in most nations. See appendix 2 for details.
The international average is the average of the national averages of the nations that reported data.
s.e. means standard error.

SOURCE: Martin et al. (2000). *TIMSS 1999 International Science Report: Findings from IEA's Repeat of the Third International Mathematics and Science Study at the Eighth Grade.* Exhibit 6.10. Chestnut Hill, MA: Boston College; Mullis et al. (2000). *TIMSS 1999 International Mathematics Report: Findings from IEA's Repeat of the Third International Mathematics and Science Study at the Eighth Grade.* Exhibit 6.11. Chestnut Hill, MA: Boston College.

Appendix 5

Comparisons of all TIMSS and TIMSS–R Nations

How does the United States perform in comparison to all TIMSS and TIMSS–R nations?

Variation in the number of nations in international studies conducted to date can make interpretation of international averages and comparisons of performance of the United States to other nations difficult. This is particularly true when attempts are made to look at changes in the relative performance of the United States over the years. However, TIMSS–R was specifically designed to allow for a direct comparison of mathematics and science achievement of eighth-graders over 4 years' time. The establishment of a common scale for the eighth grade components of TIMSS and TIMSS–R allows us to develop the best set of international comparisons, and the best estimate of the relative international performance of the United States to date. TIMSS included 42 nations. TIMSS–R included 38 nations, of which 26 are in common between TIMSS and TIMSS–R. Combining the scores of nations from TIMSS and TIMSS–R allows us to use a comparison group of 54 nations for this purpose. Not only does this increase the overall number of nations with which the United States is compared, but this extended list will also go some way toward overcoming criticisms that the comparison group of nations in the past has been biased toward developed nations with a heavy European participation.

Any attempt to combine the results from TIMSS and TIMSS–R raises the question of which national average to use for the 26 nations that participated in both TIMSS and TIMSS–R. From one point of view, it may be best to use the 1995 scores from these nations even though they have a 1999 score. In this case we would be comparing nations on the basis of their first participation in a TIMSS-like assessment. On the other hand, it may be most appropriate to use the most recent data available and so use the 1999 scores for the 26 nations in both studies. As it turns out, the results are quite similar, so for the purposes of this presentation we will use the most recent data (1999) for those nations that participated in TIMSS–R.

When looking at the data available for the 54 nations that participated in either TIMSS, TIMSS–R, or both, at the eighth grade, the United States performed above the international average of the 54 nations in mathematics. Seventeen nations outperformed the United States, 22 nations performed lower than the United States, and 14 nations performed similarly to the United States.

In science, the United States also performed above the international average of the 54 nations. Fourteen nations outperformed the United States, 26 nations performed lower than the United States, and 13 nations performed similarly to the United States

The findings from this combined TIMSS/TIMSS–R comparison are shown in table A5.1.

Relative to other nations in mathematics and science, the United States appears to have done better in science than in mathematics, if 'better' is defined as fewer nations outperforming the United States in one subject or the other. That is, when looking at the achievement of all 54 nations that participated in TIMSS or TIMSS–R, 14 nations outperformed the United States in eighth grade science whereas 17 nations outperformed the United States in eighth grade mathematics. These comparisons reflect the achievement of U.S. eighth-graders against the achievement of their peers in 53 other nations, the broadest spectrum of nations to date.

Table A5.1.—Mathematics and science acheivement of TIMSS–R and TIMSS nations with standard errors: 1995 and 1999

Mathematics			Science		
Nation	Average	s.e.	Nation	Average	s.e.
Singapore	604	6.3	Chinese Taipei	569	4.4
Korea, Republic of	587	2.0	Singapore	568	8.0
Chinese Taipei	585	4.0	Hungary	552	3.7
Hong Kong SAR	582	4.3	Japan	550	2.2
Japan	579	1.7	Korea, Republic of	549	2.6
Belgium-Flemish	558	3.3	(Netherlands)	545	6.9
(Netherlands)	540	7.1	(Australia)	540	4.4
Slovak Republic	534	4.0	Czech Republic	539	4.2
Switzerland*	534	2.7	(Austria)*	539	3.8
Hungary	532	3.7	(England)	538	4.8
Canada	531	2.5	Finland	535	3.5
(Slovenia)	530	2.8	Slovak Republic	535	3.3
France*	530	2.8	Belgium-Flemish	535	3.1
(Austria)*	529	3.1	(Slovenia)	533	3.2
Russian Federation	526	5.9	Canada[1]	533	2.1
(Australia)	525	4.8	Hong Kong SAR	530	3.7
Finland[1]	520	2.7	Russian Federation	529	6.4
Czech Republic	520	4.2	Sweden*	523	2.9
Malaysia	519	4.4	Ireland*	518	5.1
Ireland*	519	4.8	(Bulgaria)	518	5.4
(Belgium-French)*	518	3.8	(Germany)*	518	5.5
Sweden*	513	2.7	United States	515	4.6
(Bulgaria)	511	5.9	Norway*	514	2.4
(Latvia-LSS)[2]	505	3.4	New Zealand	510	4.9
(Germany)*	502	4.5	Switzerland*	509	2.8
United States	502	4.0	Spain*	504	2.3
Norway*	499	2.2	(Latvia-LSS)[2]	503	4.8
(Denmark)*	497	3.1	(Scotland)*	501	5.6
(England)	496	4.2	Italy	493	3.9
(Scotland)*	493	5.7	Malaysia	492	4.4
New Zealand	491	5.2	(Lithuania)[3]	488	4.1
Iceland*	484	4.9	France*	488	3.2
Spain*	483	2.3	(Greece)*	486	2.8
(Lithuania)[3]	482	4.3	Iceland*	484	5.8
Italy	479	3.8	(Thailand)	482	4.0
(Greece)*	479	3.4	Portugal*	473	3.1
Cyprus	476	1.8	(Romania)	472	5.8
(Romania)	472	5.8	(Denmark)*	472	3.8
Moldova	469	3.9	(Israel)	468	4.9
(Thailand)	467	5.1	(Belgium-French)*	466	3.8
(Israel)	466	3.9	Cyprus	460	2.4
Portugal*	451	3.0	Moldova	459	4.0
Tunisia	448	2.4	Macedonia, Republic of	458	5.2
Macedonia, Republic of	447	4.2	Jordan	450	3.8
Turkey	429	4.3	Iran, Islamic Republic of	448	3.8
Jordan	428	3.6	Indonesia	435	4.5
Iran, Islamic Republic of	422	3.4	Turkey	433	4.3
Indonesia	403	4.9	Tunisia	430	3.4
Chile	392	4.4	Chile	420	3.7
(Colombia)*	360	6.4	(Kuwait)*	415	5.6
(Kuwait)*	355	5.8	(Colombia)*	393	6.9
Philippines	345	6.0	Philippines	345	7.5
Morocco	337	2.6	Morocco	323	4.3
(South Africa)	275	6.8	(South Africa)	243	7.9
International average of 54 nations	486	0.6	International average of 54 nations	488	0.6

Average is significantly higher than the U.S. average
Average does not differ significantly from the U.S. average
Average is significantly lower than the U.S. average

*Denotes score from 1995 (no 1999 score available).

[1]The shading of Finland and Canada may appear incorrect; however, statistically its placement is correct.

[2]Designated LSS because only Latvian-speaking schools were tested.

[3]Lithuania tested the same cohort of students as other nations, but later in 1999, at the beginning of the next school year.

NOTE: Parentheses indicate nations not meeting international sampling and/or other guidelines in the year for which data are reported. See appendix 2 for details for 1999. See NCES (1996) for details for 1995.
The international average is the average of the national averages of the 54 nations.
1995 scores are based on re-scaled data.
s.e. means standard error.

SOURCE: U.S. Department of Education, National Center for Education Statistics, Third International Mathematics and Science Study–Repeat (TIMSS–R), unpubished tabulations, 1999.

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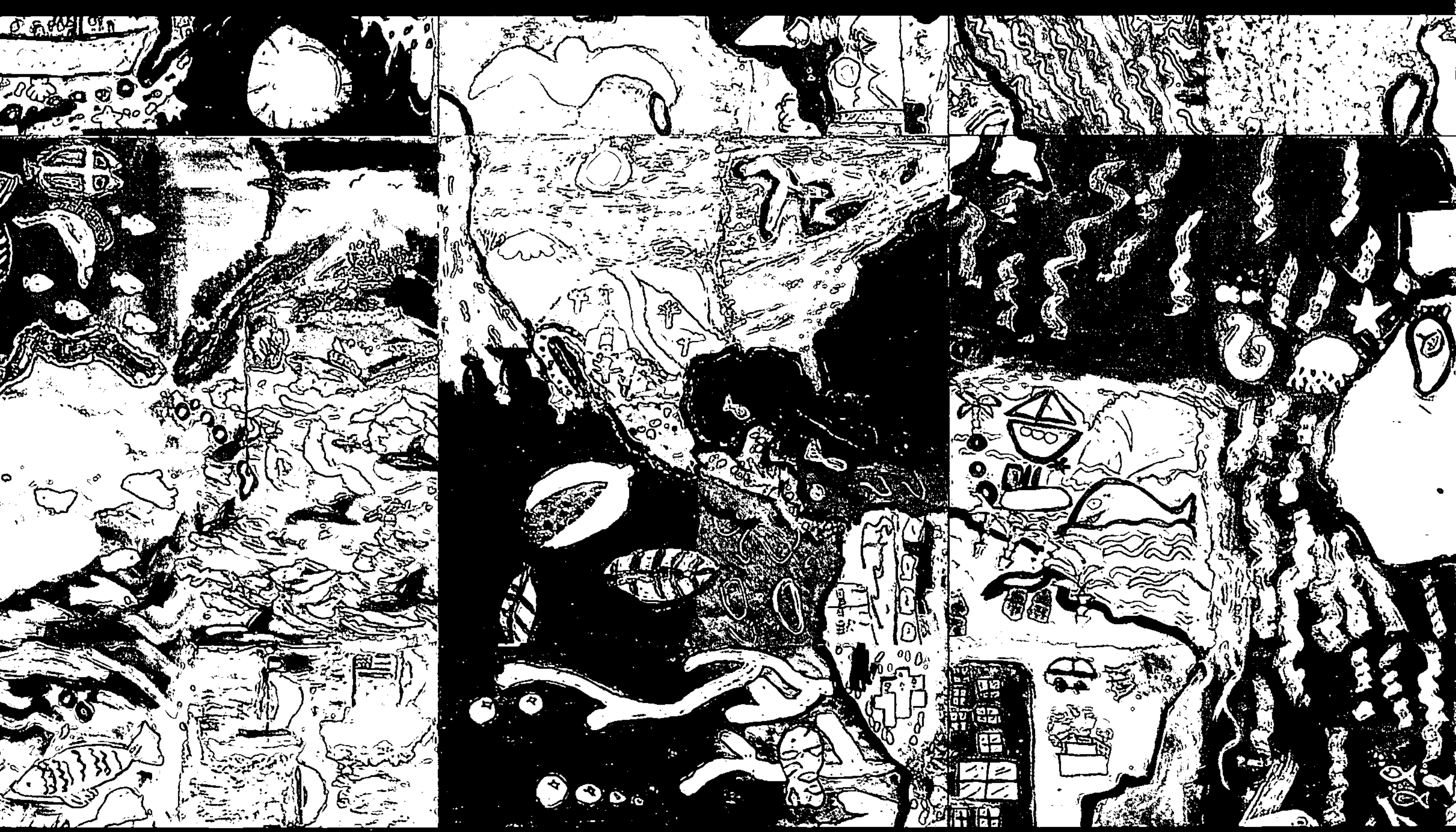

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